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INSTITUTE OF GAS TECHNOLOGY

THE GAS INDUSTRY'S OWN EDUCATIONAL AND RESEARCH FACILITY

CHICAGO 16, ILLINOIS

GAS ABSTRACTS

JANUARY, 1959

VOLUME 15 NUMBER 1

AFFILIATED WITH

ILLINOIS INSTITUTE OF TECHNOLOGY

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O. P. BRYSCH, Editor

GAS ABSTRACTS is published and distributed monthly by the Institute of Gas Technology, Chicago 16, Illinois. The contents of selected papers and patents are reviewed impartially by the editorial staff and material of potential interest to the Gas Industry is presented. Subscription rates to non-members of the Institute: $18.00 per year to U.S. addresses; $22.00 foreign—Printed in the U.S.A.

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1. MANAGEMENT

Gas Industry Expansion

1959 Drilling Total May Top 50,000. *Petrol. Week 8.* 15 (1959) Jan. 2 (3 pp.)

U.S. drilling activity should increase somewhat in 1959, although there are few areas that will have the boom outlook of 1955-56. But some areas will fall back even more than they did in 1958. Survey indicates that the balance will tip in favor of the plus factor and that 1959 should be a year for revival, albeit not a robust one. California will better 1958 pace, Texas will be strong in spots; Gulf Coast and California offshore drilling will increase; Louisiana, Mississippi, Alabama and Arkansas will experience steady to improved activity; the Rockies will continue to be a busy area, with Wyoming one of the best bets; Oklahoma activity is expected to increase. In other areas, drilling activity will continue at the 1958 pace, with increases in some local areas.

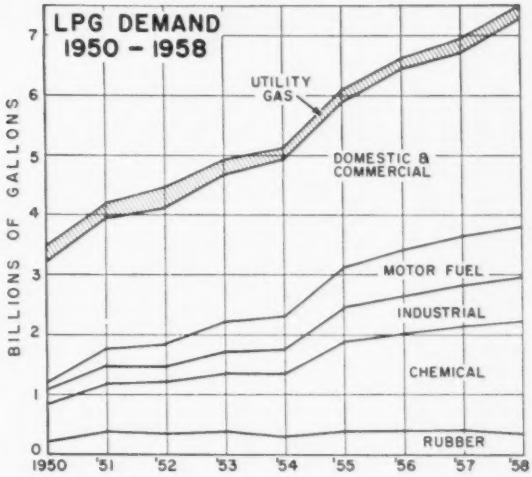
Outline for New Construction in 1959. *Construction Rev. 4,* 4 (1958) Dec. (4 pp.)

Spending for new construction is expected to rise 7% to a record $52.3 billion in 1959, thus passing the $50-billion mark for the first time. About $48.8 billion for expenditures will be spent in 1958. Public expenditures are expected to provide the major part ($17.1 billion) of the 1959 expansion in new construction. The $35.2-billion total foreseen for private construction represents a gain of $1.4 billion over 1958. Most of the $3.5-billion increase in construction expenditures for 1959 will be in residential building (public and private) and highways, which together will account for almost four-fifths of the advance over 1958. Anticipated dollar volume of new construction in 1959 is based on the assumption of a continued rise in the nation's total output of goods and services

Arkansas Louisiana Gas Co. D. Wright. *Gas 35,* 41 (1959) Jan. (14 pp.)

Arkansas Louisiana Gas Co. (Little Rock, Ark. and Shreveport, La.) by its acquisition of the Arkla Air Conditioning Corp. has achieved a position of major importance in the gas industry. It has demonstrated that a utility can diversify into other lines of business (Arkla manufactures two appliances designed to produce good gas loads—gas air conditioning equipment and gas lights—) to the benefit of its customers, stockholders, employees and the area it serves. Review of company's diversification policy, manpower problem, selling policy and operation.

El Paso Builds toward the Three Billion Mark. R. W. Adams. *Petrol. Eng. 30,* D-28 (1958) Dec. (3 pp.)



(Data from *LPG Hangs Up New Record . . .* See abstract p. 2)

FPC has given complete approval to El Paso Natural Gas Company's application to expand its pipeline capacity by 185,000,000 CF/day to supply additional gas to existing customers in Arizona and California. In a second application, field facilities intended to increase the company's daily deliveries by 100,000,000 CF/day were approved but that portion of the application proposing additional main line facilities was returned to an FPC examiner for further study.

Market Research Sells Gas. P. D. Dignan. *Gas 35,* 55 (1959) Jan. (2 pp.)

Integrated marketing research program is a must for any consumer-minded organization. Most important factor is use of information available. Market research can sell gas only if the information is applied to the selling situation. Description of marketing research operation at Northwest Natural Gas Co. (Portland, Ore.)

Gas Industry Management

The Outlook for Public Utilities-1959. F. X. Welch. *Public Util. Fortnightly 63,* 1 (1959) Jan. 1 (15 pp.); **Power Truce?** *Business Week 1533,* 34 (1959) Jan. 17 (2 pp.)

Author, whose predictions for 1958 contained no errors, compiles a new list of forecasts for 1959. New Congress, dominated by political opposition to the administration, clearly indicates possible policy conflict. These are the ten predictions. 1) TVA self-financing bill: will be enacted, but it will not be satisfactory legislation for the investor-owned electric utility industry. 2) No gas producer exemption law: outlook for law to relieve producers from the full jurisdiction of the FPC under the Natural Gas Act

is probably worse than at any time within the past decade. 3) Other gas legislation: Recent U.S. Supreme Court decision upholding FPC in Memphis case may result in new bills to require pipeline companies to get advance consent of customers to file rate increases even under service-type contracts. More serious is the drive certain to be made for elimination or curtailment of present 27% depletion tax allowance. Outcome is a tossup. 4) No change in REA law—or size appropriations: Congress will keep REA spending in manner to which it has become accustomed. Bold attempt of REA co-op lobby to make the REA independent of the Secretary of Agriculture will not succeed. 5) A hard battle for a Columbia Valley Authority: Final decision probably will not be reached in 1959. 6) AEC atomic plant building: AEC will probably be first to yield to some extent before the heavy Democratic majority. 7) Rate regulation at the state level: Number of cases before the state commissions can be expected to increase. Inflationary trend will produce more agitation for revision of rate base and rate of return procedures. State legislation in this area will not be very productive. 8) Legislation affecting telephone companies: Attempt to reduce or eliminate telephone excise taxes will meet with another failure. However, joint federal-state proposal to turn over a part of this tax to the states in return for their acceptance of certain welfare responsibilities will meet with opposition. Minimum wage probably will be increased. 9) Telephone cases before the FCC: FCC probably will uphold its examiners' decision approving the Bell system acquistion of independent company properties in Wisconsin. Two other major telephone cases before the FCC are now given less than 50% chance of success. 10) Legislative Oversight Committee: House subcommittee investigating improper influence on the federal commissions will make a critical report early next year. Effort to obtain procedural reforms by legislation probably will not become entangled in congressional controversy.

Threshold Prices: A Practical Proposal for Producer Pricing. W. R. Connole. *Public Util. Fortnightly 63,* 23 (1959) Jan. 1 (14 pp.)

Rising level of gas prices should be attacked at its source, which is the price at which new gas sales are made in interstate commerce, advocates the author, an FPC member. He offers as a solution to the gas-pricing problem a "threshold test," which is simple, certain, practical and one that can be put into effect immediately.

Estimating Interruptible Industrial Service Revenues. D. C. Neill. *Am. Gas J. 185,* 26 (1958) Dec. (3 pp.)

Interruptible industrial service, primarily an off-peak type of service designed to improve the system load factor, is applicable to gas service to commercial and industrial customers, exclusive of service to utility steam electric generating plants and similar large users, such as cement plants. These latter customers will generally be provided with an even lower rate and priority of service, dependent, of course, upon gas availability on the system. Various types of rate schedules are used for interruptible gas service.

LPG Sales

LPG Sales Up 9.4% in 1958. G. R. Benz, W. F. DeVoe and P. W. Tucker. *Butane-Propane News 21,* 27 (1959) Jan. (5 pp.); **LPG Hangs Up New Record in '58, Will Repeat in '59.** *Oil-Gas J. 56,* 36 (1959) Dec. 22 (2 pp.); **LPG Sales Rocket to New High.** *LP-Gas 19,* 31 (1959) Jan. (5 pp.); **LP Sales Hit New High.** *Gas Age 123,* 41 (1959) Jan. 8 (4 pp.)

Mounting demands for LPG, mainly in house heating, gasoline blending and chemical manufacturing, paint a rosy picture for LPG producers. Sales in 1958 will top a record 7½ billion gal. More important, the increase of 652,300,000 gal. over 1957 is 30% greater than the average annual increase of the last 9 years. Total sales are expected to reach 7,591,400,000 gal., up a solid 9.4% over last year.

Methane Liquefaction

Gulf Coast Gas Ready for England. *Oil Gas J. 57,* 76 (1959) Jan. 5 (3 pp.)

If Constock's "Methane Pioneer" successfully and safely moves gas in liquid form at the extreme temperature of –250°F, it would open up vast new sources of energy and create a profitable new branch of the petroleum industry. Studies made to date indicate that liquefied gas can be delivered in Europe cheaper than manufactured gas, and to the northeastern U.S. coast in direct competition with pipeline gas. Gas can be purchased in S. Louisiana, liquefied, loaded and discharged at the Regent Oil Co. jetty at Canvey Island (Eng.) for $.35-$.50 MCF. This compares with $1.61/MCF for manufactured gas delivered to the same point. U. S. northeastern gas distributors now pay pipeline companies from $.34.2-$.49.5/MCF at 100% load factor. One estimate puts cost of moving liquefied gas from Venezuela to New York at $.21/MCF. Sources of supply in the Caribbean, North Africa and the Middle East are ample for a high-volume movement of gas. Vast markets for liquefied gas exist in Europe, Japan and even the U.S.

Petroleum Production

Oil Recovery of the Future Will be Controlled by Management, Technology and Education. N. J. Clark. *Producers' Monthly 23,* 16 (1958) Dec. (8 pp.)

Future improvements in oil recovery will depend more and more on improved oil recovery techniques, but proper utilization of these and other recovery processes to be developed will require considerably more thorough and detailed engineering and planning than generally has been utilized in the past. In addition, however, improved operations will require improvements in areas of endeavor. Discussed are some of the more obvious areas of endeavor which include the working relation between geologist and engineer; training and development of engineers; necessary planning to provide needed information for studies; difficult role of universities in the training effort, and finally, critical role of management in the many phases of the business.

Federal Power Commission

Pauvre, Pauvre Memphis Decision . . . It's Dead! N. Regeimbal and J. F. Ebdon. *Gas 35*, 39 (1959) Jan. (3 pp.)

On December 8, 1958, the U.S. Supreme Court reestablished the conventional rate-making procedures of Sec. 4 of the Natural Gas Act as detailed in FPC Order No. 144. In a decision that upheld the FPC's established practice of letting the pipelines put higher rates into effect, subject to refund while the agency investigates the reasonableness of the increases, the five justices reversed a lower court which ruled that rate hikes could be put into effect, pending commission review, only if gas customers agreed in advance to the specific rate.

Promotion

The Laboratory's Function in Industrial Gas Practice. C. P. Henshilwood and R. H. Wharton. *Gas J. 296*, (Gas in Ind. Sec.) 199 (1958) Dec. 3 (9 pp.); **Discussion.** *Gas J. 297*, (Gas in Ind. Sec.) 16 (1959) Jan. 7 (4 pp.)

Increasing importance of gas sales to industry in the face of increasing competition is background of all work of the Industrial Laboratory at Watson House. In 1950-51, the sales of gas to industry accounted for 590 million therms, but by 1957-58 this had risen to 786 million therms, an increase of 33%. Article points out how laboratory operates in assisting promotion of industrial gas. It is shown that most of the laboratory work requires, at one stage or another, consideration of design.

Patents

The Patenting of Chemical Inventions. J. M. Soesan. *Chem. & Ind.* 1640 (1958) Dec. 13 (6 pp.)

Article examines main requirements for patentability and the practical difficulties which arise in the patenting of chemical inventions, and suggests ways and means by which these difficulties can be avoided or minimized. Law makes no distinction between chemical and other inventions, but there are difficulties which arise in the patenting of chemical inventions which do not arise, or arise to a lesser extent, in the case of mechanical or electrical inventions. As defined by the author, chemical inventions include all inventions in which the chemical properties of materials are involved and not only those relating to the products of the chemical industry proper.

Appliances

1959 Gas Engineering and Appliance Directory. *Gas Age 122*, 23 (1958) Dec. 25 (76 pp.)

Comprehensive directory of all sources of supply now available. It provides a classified list of every important product used in the gas industry.

Pipeline Construction

Head of Pipe Line Contractors Looks at His Industry. *Oil Gas J. 57*, 46 (1959) Jan. 12 (2 pp.)

R. P. Gregory, president of the Pipe Line Contractors Association, answers questions on costs, prospects for automatic welding, relations between the contractors and pipeline companies and the contractors and labor.

Education

Pyrofax Gas Launches New Home Study Course. W. W. Clark. *Butane-Propane News 21*, 37 (1959) Jan. (2 pp.)

New tool introduced in 1958 by Pyrofax Gas Corp. is a Gas Service Home Study Course for its dealers and their personnel. Course is designed to make the serviceman a better qualified employee, one who will build good will for his employer by doing a more expert job on the appliances and equipment he services. Almost equal in importance is the fact that it will give him a stronger sense of participation. Outline of seven-course curriculum is included.

Information

Engineering Information. R. H. Phelps. *Mech. Eng. 80*, 68 (1958) Dec. (2 pp.)

Through the activities of the Engineering Societies Library and the Engineering Index, engineers have a unique documentation center and coordinated services unmatched elsewhere in the world. Discussion of how assembling, filing and locating of engineering information are accomplished.

Safety

How Do Pipeliners Get Injured? *Pipe Line News 30*, 18 (1958) Dec. (2 pp.)

Analysis of ten-year Shell Pipe Line Corporation accident record gives clearer understanding of types

of accidents which should be watched for and ways to prevent them. Reasons for accidents also are discussed.

Informed Supervisors Vital to Accident Prevention. W. W. Clark. *Gas 35,* 57 (1959) Jan. (3 pp.)

Interview with R. N. Papich, A.G.A.'s safety consultant, who feels that while the impact of the dynamic A.G.A. safety program is beginning to be felt through a declining frequency, the job is far from done. Biggest hurdle is a management who feels that accidents are inevitable.

2. ENERGY SUPPLY AND ECONOMICS

Petroleum Reserves

World-Wide Oil Report. P. Swain and R. Gibson. *Oil Gas J. 56,* 87 (1958) Dec. 22 (47 pp.)

Comprehensive annual year-end roundup of oil and gas activity throughout the world, with the exception of the United States and Canada. Maps, statistical tables and short discussions are presented for oil countries in Central and Latin America, Europe, the Middle East, the Far East and Africa. Recapitulation of figures includes reserves, producing and drilling wells, production and refining capacities.

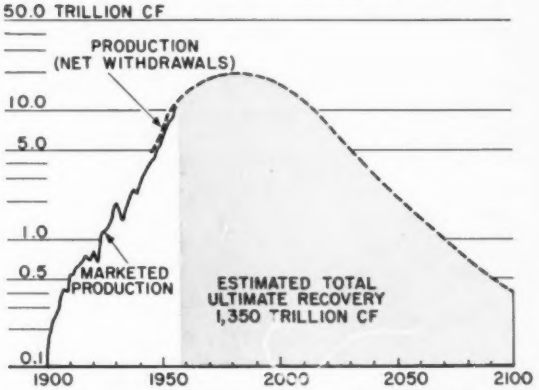
Let's Stop Selling U.S. Reserves Short. M. J. Davis. *Oil Gas J. 56,* 80 (1958) Dec. 8 (6 pp.)

First question of immediate public interest is current availability of petroleum supplies. This question has been asked of the National Petroleum Council several times since 1947, and resulting studies have consistently shown availability from domestic wells increasing at a faster rate than domestic demand. Council's latest report showed an ability to produce 9,867,000 bbl/day of crude oil as of January, 1957. By contrast, production of crude oil in 1958 will probably average less than 6,800,000, indicating a reserve producibility of not less than 3,000,000 bbl/day.

Venezuela's Oil Industry Is Sound. *World Petrol. 29,* 44 (1958) Dec. (4 pp.)

In all four major areas of Venezuela's oil industry, long-range prospects are good. Although number of new wells this year will be only around 1300 compared with 1825 in 1957, results of new concessionaires' work in Lake Maracaibo and the Gulf of Paria have been spectacular. Based on the 2,539,500 bbl/day average during the first seven months of 1958, production will be only about 6% below 1957 (a billion-barrel year), and still above 1956. Pipeline projects underway will enable handling of an additional 1.5 million bbl/d of oil by the end of the year. Three established refiners, Creole, Shell and

Pattern of Minimum Future Natural Gas Production in the United States



(From *Future Growth of the World Petroleum Industry.* See abstract p. 5)

Richmond, plan substantial increases in their capacity. Added to these will be first new refinery built in Venezuela for many years, the 40,000 bbl/d Socony Mobil plant at Pto. Cabello.

Oil Being Formed at Present Time Study of Field in Venezuela Shows. *Oil Gas J. 56,* 70 (1958) Dec. 8.

Team of scientists from three affiliates of Standard Oil Co. (New Jersey) are studying an extraordinary oil deposit containing oil only 5000-10,000 years old—still in embryonic stage of its development. Oil in average commercial well is more than 10 million years old. Jersey Standard says oil deposit—discovered in 1954—provides first opportunity to observe nature in act of creating an oil reservoir. It is the only case known in which hydrocarbons have actually begun to collect in a stratigraphic trap.

Russian Gas Supply

Prospective Development—and the Present Situation—of Gas in the U.S.S.R. M. Sidorenko. *Gas J. 296,* 391 (1958) Nov. 26 (2 pp.); *Gas World 148,* 1024 (1958) Nov. 29 (2 pp.); *Gas Times 92,* 40 (1958) Dec.

According to preliminary calculations, in the next seven or eight years all work in supplying cities and the most important industrial and cultural centers of the country located along the natural and casinghead-gas lines already existing and to be put into operation will be basically completed. During this same period it will be necessary to ensure a supply of liquid gas to the population of a number of workers' settlements and rural localities. This will make it possible to supply gas by 1965 to about 35% of the entire population of the U.S.S.R. Extensive provision of gas to towns and villages, alongside the development of an immense scale of housing con-

struction in the U.S.S.R. is an important factor in raising the living standard of the people. Use of gas for domestic purposes will free millions of workers from unproductive work.

Shale Oil

U.S. Pushes Atom Test for Oil Shale. *Petrol. Week 8,* 10 (1959) Jan. 2; **Can Underground Blast Make Shale Oil Competitive?** *Oil Gas J. 57,* 58 (1959) Jan. 12 (2 pp.); **Peaceful Bomb Hits Snags.** *Business Week 1533,* 34 (1959) Jan. 17.

Oil industry will be asked to back a test nuclear blast to free oil from shale. Two government groups think it is feasible, and will present data to some 50 organizations meeting in Dallas in mid-January. If the oil industry agrees to participate in such a program with the government, the testing probably will not occur until 1960.

Energy Sources

Fuel Availability and Future Power Demand. H. W. Nelson (Chicago: Proc. Amer. Power Conf. (1958) Mar.) 351 (10 pp.)

Trends in thinking are examined on the problem of future energy supplies, especially on thermal generation of electric power and sources of fuel. Forecasts by electrical industry and government groups indicate a doubling every 10 years since 1940 and a rise in electric generating capability from 116.5 million kw in 1955 to a range of 300-500 million kw in 1975, and 350-700 million kw in 1980. Estimates of the President's Material Policy Commission, the McKinney Panel, the FPC and others are reviewed for the fuels for power. For 1955, generating fuel comprised 69% coal, 9% oil and 22% gas. This represents 14% of all gas and 2% of all petroleum consumed annually. Most recent studies of coal, oil and gas reserves and future requirements are reviewed.

Britain's Fuel and Energy Needs. The Next Ten to Twenty Years. A. Parker. *Gas World 148,* 1201 (1958) Dec. 27 (3 pp.)

From a survey of the position it is concluded that the coal equivalent of the indigenous coal, oil and hydroelectricity produced each year in the United Kingdom will not change much in total over the next 10-15 years, and will be between 220 and 230 million tons/yr. Demand for fuel and power will increase, with fluctuations, from present coal equivalent of between 250-255 million tons/yr to reach 275-280 million tons by 1968-70, or by the equivalent of about 25 million tons. Three-fifths of this increase will be provided by electricity from nuclear power stations and two-fifths by the use of an additional 6 million tons of petroleum oils. Use of raw coal will decline and will be about balanced by an increase in the quantity of electricity from coal-fired power stations.

Petroleum Energy Sources

Future Growth of the World Petroleum Industry. F. G. Coqueron, H. D. Hammar and J. G. Winger. (New York: The Chase Manhattan Bank, Petrol. Dept. (1958) Nov. (48 pp.))

Third in a series of reports on a continuing study of the long range outlook for petroleum. Objective of study is to aid corporate and national planning. It is concluded that the double expansion of population and per capita use of primary energy will, by 1967, lead to an energy requirement in the U.S. approximating 63.5 quadrillion Btu. Petroleum equivalent of that energy volume is 30 million bbl/day. Thorough study of four primary sources of energy—liquid petroleum, natural gas, coal and water power—indicates that oil may be expected to capture 48% of the energy market. This is equivalent to 14.4 million bbl/day. It is stressed, however, that future demand for oil is contingent upon the availability of natural gas. Gas enjoys a marked competitive advantage by virtue of its low wellhead price. If future availability of natural gas should be greater than anticipated, demand for oil will be lower. Capital expenditures necessary to support expansion foreseen in the next decade may total $140 billion. Expenditures in the free foreign areas are expected to rise about 140% during this period; in the U.S. an increase of 70% is anticipated.

Underground Gasification

Energy and Economic Evaluation of the Parameters of Several Underground Gasification Processes. C. D. Pears, J. P. Capp and M. H. Fies. (Proc. Amer. Power Con. (1958) Mar.) 335 (11 pp.)

Many earlier advocates of underground gasification thought in terms of producing a gas that could be used to make a transportable gas as the end product. Today, the end product generally is considered to be on-site-generated electrical power. Present promising systems tested include blind borehole, electro linking, pneumatic linking and fracturing with fluid injection. These are compared in terms of process cost per million Btu in gas produced. Despite the poor energy recovery, further research is urged with the objective of reducing costs and enabling a commercial application in the utilization of low-grade coals.

Coal

A Special Report on Coal and Power. Ten Important Questions. *Coal Utilization 12,* 19 (1958) Dec. (12 pp.)

Everything points to a prodigious expansion of the electric utilities industry with the firm prospect that coal will be called upon to meet vastly greater fuel requirements than exist today. Situation calls for joint long-range planning and closer cooperation on

the part of the utility, coal and related industries. Leaders in the power and coal industries answer ten important questions in an effort to define the size and shape of things to come. Authorities are: M. H. Ankeny, Director, U.S. Bureau of Mines; E. H. Man, Consolidated Edison Co. of New York, Inc.; S. N. Fiala, American Electric Power Service Corporation; A. A. Casey, The Cleveland Electric Illuminating Company; H. G. Schmidt, The North American Coal Corporation; P. Sporn, American Electric Power Company, Inc.; E. H. Krieg, Stone & Webster Engineering Corporation; J. D. A. Morrow, Joy Manufacturing Company, and J. E. Tobey, Appalachian Coals, Inc.

Nuclear Energy

Status and Prospects of Nuclear Power. An Interim Survey (Status as of July, 1958.) Tech. Appraisal Task Force on Nuclear Power. (New York: Edison Elec. Inst.; Publication No. 58-13.)

Objective review of present status and future prospects for production of electric power from nuclear fuels. Review is in the nature of a progress report intended to give reader a grasp of problems involved in developing commercial atomic power as they now appear. Report should be of help in making a choice among those types of reactors which appear today to hold greatest promise of attaining competitive power costs. Areas of potential research and development are described and their importance stressed.

Fuel Cells

Short Cut to Electrical Energy. *Business Week 1527,* 37 (1958) Dec. 6 (3 pp.); **Fuel Cells May Star in Satellite Power Picture.** *Chem. Eng. 65,* 30 (1958) Dec. 29.

Lockheed's new fuel cell, now in advanced development, turns chemical energy into electrical in one step. It's portable, compact and may even power automobiles some day. It can be made in almost any size, depending upon how much power is needed.

3. NATURAL GAS AND PETROLEUM PRODUCTION

Drilling

Shell's 5 Rumberger Bottomed at 24,002 ft. to Become World's Second Deepest Well. W. B. Bleakley. *Oil Gas J. 56,* 77 (1958) Dec. 8 (3 pp.)

This 24,002-ft well is currently the world's second deepest, and the Beckham County test is the deepest yet in Oklahoma. It took Helmerich & Payne 15 months from spudding to total depth. Purpose is to explore the Des Moines and Springer sands.

Drilling Mud

Chemicals in Drilling Mud. G. R. Gray. *Oil Gas J. 56,* 90 (1958) Dec. 15 (9 pp.)

Discussion of why, where and when chemicals are added to drilling mud and a survey of some figures on cost. Total expenditures for materials used in drilling fluids approached $150,000,000 in 1957. Mud program becomes increasingly significant as wells are drilled deeper, and composition of drilling mud becomes more critical. Major topics of discussion include: 1) why drilling fluids are used; 2) composition of drilling fluids; 3) clay; 4) lost-circulation materials; 5) dispersing agents; 6) chemicals to counteract contaminants; 7) products for special application; 8) oil-base drilling fluids, and 9) future application for chemicals.

The Effect of Temperature on the Flow Properties of Clay-Water Drilling Muds. S. Srini-Vasan and C. Gatlin. *J. Petrol. Tech. 10,* 59 (1958) Dec. (2 pp.)

Flow property variation with temperature to 200°F of clay-water muds may be predicted by method presented. Method does not apply to other systems which might undergo appreciable chemical alteration at the temperatures in question.

Exploration

Great Basin: Giant Sleeper of the West. E. B. Heylmun. *Oil Gas J. 56,* 138 (1958) Dec. 8 (4 pp.)

Vast, sweeping deserts and isolated mountain ranges of western Utah and eastern Nevada have, with but two exceptions, offered nothing but discouragement to the driller in search of commercial oil or gas production. Yet, geologically, region has a great deal of merit as a potentially productive oil and gas province. Article points out some facts that should cause even most conservative oil man to ponder possibilities of region.

Logging

Watch Those Log Readings! J. K. Kerver and C. L. Prokop. *Oil Gas J. 56,* 102 (1958) Dec. 15 (5 pp.)

Sands appear more shaly on the potential curve with oil or gas present. The SP reading may be altered to the point that some quantitative interpretations may be affected. High hydrocarbon saturation and low water salinities make readings even lower. Readings should be especially watched in sands having small pore channels.

Offshore Operations

Offshore Hunt Pushed. *Oil Gas J. 56,* 78 (1958) Dec. 29 (2 pp.)

Development drilling program is centering around Santa Barbara County, Calif., with activity at Summerland, where California Standard is drilling past 4000 ft on its second well on a 5500-acre lease it

holds jointly with Humble; at Rincon, where Richfield Oil Corp. is getting ready to spud its third test on a 1170-acre lease, and at Coal Oil Point, where Richfield recently resumed core drilling from a floating barge on its 1-by-3-mile offshore lease just west of Santa Barbara.

Petroleum Production

Proration and the Petroleum Engineer. J. E. Garrett. *Petrol. Eng. 30,* B-51 (1958) Dec. (5 pp.)

Three primary objectives of proration are: 1) prevention of waste; 2) to provide equity or to protect correlative rights, and 3) to provide incentive for continued exploration and efficiency in the industry. Some of the principal subjects that must be dealt with in proration include spacing, allocation formula, MER, secondary recovery, unitization, cement setting time, depth of surface casing, dual or triple completions and spacing exception.

Recycling

High Pressure Cycling with Hydrogen Sulfide Laden Gas. C. O. Miller. *J. Petrol. Tech. 10,* 25 (1958) Dec. (4 pp.)

Description of use of hydrogen sulfide laden gas in high pressure cycling in the New Hope, Smackover field, Franklin County, Texas. Smackover gas-condensate reservoir was discovered by completion of the T. J. Ramey Unit 1-1-D well with open hole 12,086-12,322 ft. On test the well yield was approximately 150 bbl of "sour" condensate per million cubic feet of sour or hydrogen sulfide laden gas.

Reservoir Engineering

A Comparison of Calculated k_{rg}/k_{ro} Ratios with a Correlation of Field Data. M. A. Torcaso and M. R. J. Wyllie. *J. Petrol. Tech. 10,* 57 (1958) Dec. (2 pp.)

It is shown that k_{rg}/k_{ro} ratios computed on the assumption that the average sandstone reservoir has a pore size distribution characterized by a linear $1/P_c^2$ saturation plot are in good agreement with corresponding k_{rg}/k_{ro} ratios obtained by Wahl, Mullins and Elfrink by the correlation of field measurements.

Secondary Recovery

Recent Progress in Oil Recovery by In-Situ Combustion. J. S. McNiel, Jr. and J. T. Moss. *Producers' Monthly 23,* 25 (1958) Dec. (8 pp.)

Important derived quantities in design of specific in-situ combustion operations, designated in the article as design factors, are reviewed briefly on basis of characteristic operating variables. Operating problems of high production-well temperatures, corrosion, sanding and oil-water emulsions are discussed. Survey of 13 recent and proposed field operations is included to show range of conditions encountered in field tests and widespread interest that has developed over the past decade. Future application of in-situ combustion to Texas oil deposits is considered.

Well Practice

Controlling Sand in Gas Wells. G. Harper. *Petrol. Eng. 30,* B-78 (1958) Dec. (3 pp.)

Union Oil Company has found consolidation with plastic an economic solution to sand problem in gas wells. Success ratio is high and there is no indication that reservoirs are damaged through the use of these plastics. By this means, wells have been depleted without resorting to expensive remedial measures. Required flow rates have been safely maintained through high-pressure equipment while handling as much as 1000 bbl/day of salt water.

Get Better Completions with Modern Drill-Stem Testing. W. B. Bleakley. *Oil Gas J. 56,* 58 (1958) Dec. 22 (6 pp.)

Drill-stem test is one of the most informative methods of evaluating a formation and the type of completion which should be made. Several new techniques have been developed recently. These include: 1) a wire-line retrievable test; 2) acid formation cleaner; 3) straddle-packer tester without anchor pipe; 4) support for small packers to prevent extrusion in large bore holes, and 5) combination tool with inflatable packer for testing in open hole. Use of one or more of these, plus proper selection of older methods, will result in much better testing and ultimately in more production.

The Selection of a Multiple Completion Hook-Up. W. S. Althouse, Jr. and H. H. Fisher. *J. Petrol. Tech. 10,* 12 (1958) Dec. (9 pp.)

Reasoning behind inception, rate of development and successful application of current dual, triple and quadruple completions is highly economic in character. Selection of a practical multiple completion hook-up must necessarily involve strong economic considerations. Type and subsequent cost of any multiple completion hook-up is directly related to number of zones to be produced and workover and artificial-lift requirements of each zone. Analysis of available subsurface equipment that makes modern multiple completion practical in the light of design, advantages and limitations provides a base for selection of components. Systematic presentation of multiple completion hook-ups from simplest, most inexpensive two-zone completion to most complex four-zone completion, in order of increasing cost and flexibility provides a graphic systematic base for selection of a practical multiple completion hook-up.

Secondary Recovery

Petroleum Production by Underground Combustion. G. F. L. van Utenhove, H. T. Tadema and D. C. Kets (assigned to Shell Development Co.) U. S. 2,862,557 (1958) Dec. 2.

Operation of an in-situ combustion method for oil production is improved by reversing occasionally the inlet gas injection and allowing the oil near the outlet header to flow back toward the inlet where it can be reignited and the older gas paths reheated to recover more oil.

4. GAS CONDITIONING AND LPG RECOVERY

Carbon Dioxide Removal

How CO_2 Removal Plants Are Working. R. O. Palo and J. B. Armstrong. *Petrol Refiner 37*, 123 (1958) Dec. (6 pp.)

Successful application of the hot potassium carbonate process to natural gas is shown in the operating data from the first two units. Built in 1957, these plants are located at Taft, Calif.—the AP-2 plant of Honolulu Oil Corporation and the 1-C plant of the Standard Oil Company of California, Western Operations, Inc.

Dehydration

The Relative Importance of Condensation and Coalescence Processes on the Stability of a Water Fog. G. A. H. Elton, B. J. Mason and R. G. Picknett. *Trans. Faraday Soc. 54*, 1724 (1958) Nov. (7 pp.)

Theoretical analysis of processes which influence stability of a water fog contained in an isothermal enclosure is presented. Changes in droplet size distribution brought about by coalescences between droplets of different sizes, and also by the distillation of water vapor from droplets smaller than average on to those larger than average, are computed. It is shown that, for a droplet population having initially a normal droplet size distribution, the evaporation-condensation process is the more important if the mean droplet radius is less than 7μ, assuming the collection efficiencies for droplets in this size range to be at least 0.1. Although the calculations have been made for a water fog, the theory is generally applicable to any similarly dispersed system. The effect of dissolved electrolytes in the droplets is to increase the stability of the fog.

Dust Removal

Removal of Dust from Drip-pots in Long Distance Pipelines. G. Hartmann and H. Jerig. *Gas- u. Wasserfach 99*, 1169 (1958) Nov. 7 (2 pp. German text.)

Diagrams of six types of dust filtering and transporting devices, and their operating procedures, are discussed.

Simultaneous Removal of Acid Gases, Mists and Fumes with Mineral Wool Filters. C. E. Billings, C. Kurker, Jr. and L. Silverman. *J. Air Pollution Control Assoc. 8*, 185 (1958) Nov. (18 pp.)

Investigations of acid gas, mist and fume removal with mineral wool filters have indicated that 2-in. thick filters at 4 lb/ft^3 packing density will remove up to 80% of acid mist and up to 99% of acid gases and fumes. Total filter life depends upon concentration of contaminant in the entering air. Tabular summary of filter performance is given. Estimated operating life based upon one use of the filter material also is tabulated. With particulates such as iron oxide and fly ash, it has been found possible to wash and reuse filters about ten times. When iron oxide was collected simultaneously with SO_2, filters were reused only about eight times.

Hydrogen Sulfide Removal

The Influence of Frequency of Rotation on the Behaviour of Oxide Purifiers. J. M. Brown, S. C. Porter and R. J. S. Thompson. I. G. E. Communication No. 535. *Gas World 148*, 977 (1958) Nov. 22 (2 pp.); *Gas Times 92*, 29 (1958) Dec. (2 pp.); *Coke and Gas 20*, 503 (1958) Dec. (3 pp.); *Gas J. 296*, 562 (1958) Dec. 24 (5 pp.) **Discussion.** *Gas World 148*, 1078 (1958) Dec. 6.

Interim account of work being conducted on the influence of frequency of rotation on the behaviour of oxide purifiers. Theoretical considerations and laboratory investigations are discussed. An account is given of preliminary investigations carried out on an installation of tower purifiers under operational conditions. Influence upon efficiency of hydrogen sulfide absorption in the first taker, of load factor, hydrogen sulfide concentration and of life and initial sulfur loading of oxide charges is indicated. Practical aspects of increased frequency of rotation with particular reference to valve operation also are considered.

Liquid Reagents for the Final Removal of Hydrogen Sulfide from Gases. W. B. S. Newling. G. C. Communication 46. *Gas World 148*, 984 (1958) Nov. 22 (2 pp.); *Coke and Gas 20*, 502 (1958) Dec. (2 pp.); *Gas J. 296*, 481 (1958) Dec. 10 (4 pp.); *Gas Times 92*, 33 (1958) Dec. **Discussion.** *Gas World 148*, 1083 (1958) Dec. 6.

Article describes washing of fuel gases containing low concentrations of hydrogen sulfide to give gas of better than statutory purity. Reagents described

are alkaline suspensions or solutions of zinc compounds; sulfur product is precipitated zinc sulfide. Attention is confined to gases containing concentrations of hydrogen sulfide up to about 10 ppm by volume so that it is economic to waste the zinc sulfide formed, or to dispose of it at ore value.

Removal of Hydrogen Sulfide from Gas Using an Organic Oxygen Carrier. J. E. Davis, J. E. Mills and C. Ryder. G. C. Communication No. 45. *Gas World 148,* 979 (1958) Nov. 22 (4 pp.); *Coke and Gas 20,* 505 (1958) Dec. (2 pp.); *Gas Times 92,* 58 (1958) Dec. **Discussion.** *Gas World 148,* 1080 (1958) Dec. 6.

Developments in the production of gas under pressures of several atmospheres have revived interest in processes for the removal of hydrogen sulfide from these gases by liquid reagents. Article discusses features to be desired in such processes, and it is shown how most of these features can be obtained by employing a washing medium in which an organic dyestuff acts as an oxygen carrier. Basic idea is not new, but work reported has aimed at development of a process of practical value. Some years of experience with a small pilot plant are now being followed by the construction of a plant to purify 10,000 CF of gas/hr.

Hydrogen Sulfide Removal

Recovery of Hydrogen Sulfide and/or Carbon Dioxide Substantially Free from Hydrocarbons and Substantially Pure Hydrocarbons by Chemical Treatment of an Impure Hydrocarbon Stream. W. A. Goldtrap and B. Skinner (assigned to Phillips Petroleum Co.) U. S. 2,860,030 (1958) Nov. 11.

Hydrocarbon gases are purified from hydrogen sulfide and/or carbon dioxide by contacting under pressure with an absorbent which chemically reacts with the latter gases (monoethanolamine), recovering pure hydrocarbon gas, flashing the rich absorbent to remove dissolved hydrocarbon vapors, stripping the flashed absorbent to recover H_2S, scrubbing the flashed vapors with lean (stripped) absorbent to remove traces of H_2S and adding hydrocarbon vapors to the main purified stream.

5. NATURAL GAS TRANSMISSION

Automation

Telecontrol Helps Texas Eastern Meet Line-End Peaking Periods. *Gas Age 122,* 28 (1958) Dec. 11 (4 pp.)

Automatic controls span 50-mile gap and include such detecting devices as monitoring valve positions, engine and station condition, fire, explosive mixtures and unauthorized entry of personnel.

Compression

Studies of Jet Compression. I. Apparatus and Methods. Results with Air at Room Temperature. H. J. Hoge, S. S. Eichacker and D. L. Fiske. *Appl. Mech. Rev. 11,* 696 (1958) Dec. (From ASME semi-annual meeting, (1958) June.)

Experimental jet compressor (ejector) employing gases at subatmospheric pressures is described and data are presented showing efficiencies obtained with air used as both the driving and driven fluid. Technique is described by means of which efficiency may be determined as a function of outlet pressure and entrainment ratio. Curves are presented showing that efficiency passes through a maximum as outlet pressure is increased. Compression ratio of driven fluid likewise passes through a maximum as the outlet pressure is increased, but the maximum of efficiency occurs at a slightly higher pressure than the maximum of compression ratio. Highest efficiency achieved was 20.6%, at an entrainment ratio of 1.3 and a compression ratio of 1.14. Ratio of pressure of driven stream to pressure of driving stream at time of contact has been determined. Value of this pressure ratio corresponding to maximum efficiency was found to increase linearly with entrainment ratio, over most of the range of measurements.

From authors' summary

Engines

Predict Performance of Turbo-Engines. R. Birmann and E. W. Blattner. *Pipe Line Ind. 9,* 16 (1958) Dec. (7 pp.)

Individual calculations to predict effect of varying conditions on turbocharged engines is time consuming. One solution was to establish a set of curves that can be used to predict effect of changes in ambient temperature, atmospheric pressure and nozzle area on turbocharger RPM, flow delivery, pressure ratio and other turbocharger characteristics. Curves were computed for turbochargers operating with 2- and 4-cycle diesel engines and with the centifugal compressor as a driven unit.

A Study, Using Radioactive Lubricating Oil, of the Rate of Oil Consumption in an Operating Diesel Engine. M. Pobereskin, D. N. Sunderman and E. J. Fithian. (ASME Paper No. 58-A-143) New York: ASME.

Studies were conducted on an operating Cooper-Bessemer FW-6-T diesel engine, using radioactive lubricating oil, to determine a possible correlation between break-in wear and oil consumption. Also, oil consumption was investigated as a function of engine load, speed, temperatures and piston-ring configurations. In general, experiments proved feasibility of tracer method in determining rates of lubricating oil consumption as a function of operating

conditions. No indication of a correlation between rate of wear and rate of oil consumption was found. It was indicated that early wear is largely independent of oil consumption.

Pipeline Construction

Building a 12-Mi. Long Pressure Vessel. B. Quarles. *Pipe Line News 30,* 21 (1958) Dec. (7 pp.); **Engineering Twin 55- and 43-Inch Lines.** F. E. Culvern. *Pipe Line Ind. 10,* 37 (1959) Jan. (6 pp.)

Dual 55⅜-in. O.D. lines move coke oven-natural gas mixture. Dual pipeline differs radically from any existing systems. Most visible difference is size of line pipe used. System contains, in each of the parallel lines, eight miles of 55⅜-in. and 4¼ miles of 43¼-in. pipe. Two lines stretch approximately 12¼ miles, starting at U. S. Steel's Clairton Works (near Pittsburgh) and terminating at firm's Homestead Works.

Double Jointing to Be Done on Right-of-Way. P. Reed. *Oil Gas J. 56,* 72 (1958) Dec. 29 (2 pp.); **Double Jointing Is Speeded.** *Oil Gas J. 57,* 70 (1959) Jan. 5; **Fully Automatic Double Jointer.** *Petrol. Eng. 31,* D-44 (1959) Jan.

Description of newly developed automatic-welding technique using the submerged-arc process for use in a portable double-jointing plant designed especially for the right-of-way. Technique incorporates a copper backup ring protected by a special woven-glass sleeve. Ring mounted on the internal lineup clamp makes it possible to run a root bead automatically as the first bead on the outside of the pipe. Technique requires only two beads—both applied on the outside of the pipe. Convenient method of running root bead automatically has baffled welding experts. Second article describes Bechtel Corp.'s operations with the new method in the field.

Pipeline Operations

Canadian Crude Line Cleaned for Gas Service. R. E. Tschupp. *Pipe Line Ind. 9,* 42 (1958) Dec. (2 pp.)

To thoroughly clean interior surface of a crude line before transferring it to gas service, a combination of scrapers and a solvent detergent solution was used. Progress of cleaning batch through the line was checked by attaching a radioactive source to lead plug. Rate of flow was controlled to give ten minutes contact time between cleaning solution and pipe wall. Scintillators spaced at intervals indicated a rate of flow of one mile/hr.

Preventive Maintenance of Pipelines, Gathering Systems. Kansas-Nebraska Natural Gas Co. H. Hellon. *Gas 35,* 94 (1959) Jan. (2 pp.); **Colorado Interstate Gas Co.** K. Henderson. *Ibid.,* 98 (1959) Jan. (2 pp.); **Panhandle Eastern Pipeline Co.** K. W. Richardson. *Ibid.,* 99 (1959) Jan. (2 pp.)

Details of preventive maintenance programs carried out by three major gas transmission companies. Though the methods differ in each case, purpose is the same—keep gas flowing through the pipelines at all times.

Pipeline Operations

Pipe-Cleaning Machine. F. M. Matheny (assigned to Pipe Linings, Inc. U. S. 2,860,356 (1958) Nov. 18.

Pipe-cleaning machine is claimed, comprising spaced annular plates, carrying cutter and scraper devices to be slidable in pipeline by pressure of water, the motion being controlled by resistance to motion by pipe obstructions which permits release of pressure of driving water through a slidable valve in front plate of machine.

6. GAS AND LPG STORAGE

Methane Liquefaction

Ocean Transportation of Liquefied and Petroleum Gases. L. von Szeszich. *Oil Gas J. 57,* 76 (1959) Jan. 12 (6 pp.)

Comprehensive roundup on current status of investigations including types of gas, methods of liquefaction, transportation, regasification and over-all economics. Cost for a specific case is based on assumption of 4500 sea miles between source and market. Regasified methane at point of use would cost $0.512-$1.324/MSCF. Thus the fuel would be competitive in many markets around the world.

Underground Storage

A Venture in Underground Gas Storage. *Gas World 148,* 1197 (1958) Dec. 27 (3 pp.)

Historic review of Laclede Gas Company's (St. Louis, Mo.) venture into underground storage. Initial injection was begun on Dec. 2, 1955, in the structurally highest well on the storage field. As soon as gas from this well migrated to each of the other three wells, they were put into service as injection wells. Initial injection pressure was approximately 670 lb. Injection was slow at first because of resistance offered by wet sand to incoming dry gas. But as gas bubble increased in size, greater quantities of gas could be injected without an increase in pressure. Laclede has considered it essential to maintain conservative injection levels at all times.

What to Consider When Evaluating Underground LP Storage. C. T. Brandt. *Gas Age 122,* 37 (1958) Dec. 11 (4 pp.)

Article answers four basic questions that must be considered in regard to underground LP storage—cost, physical considerations, what investigations are necessary and construction time. Answers provide a guide for those contemplating underground storage of LP gas.

Underground Storage

Underground Storage Cavern Having Laterally Spaced Well and Method Therefor. H. V. Hendrix (assigned to Phillips Petroleum Co.) U.S. 2,861,428 (1958) Nov. 25.

Improved method of forming a solution cavity for storage of hydrocarbons in deep salt strata is claimed. It comprises drilling and casing the usual hole to the salt strata, then drilling deeper but directionally at an angle. A second hole then is drilled and cased to intercept the first so that water entering the first will dissolve salt and percolate downward with decreasing dissolving action to the intercept well from which the brine can be pumped to the surface. No dissolving or strata disturbing action occurs at the outlet well, which is always clear for pumping out the stored hydrocarbons.

7. MANUFACTURED GAS AND CHEMICAL PROCESSING

Ammonia

The Gasification of Solid Ammonium Nitrate. W. H. Anderson, K. W. Bills, A. O. Dekker, E. Mishuck, G. Moe and R. D. Schultz. *Jet Propulsion 28*, 831 (1958) Dec. (2 pp.)

When the surface of solid ammonium nitrate is superheated by a high flux heating technique, the ammonium nitrate decomposes in a different manner than the bulk phase liquid. According to the observations described, rate-controlling process in linear pyrolysis of solid AN occurs in surface layer only, and not below the surface. Surface reaction is highly endothermic. Possibility of partial decomposition in the subsurface layers is not ruled out, but this partial decomposition is not considered to be rate-controlling.

The Radiation-Induced Formation of Ammonia. C. H. Cheek and V. J. Linnenbom. *J. Phys. Chem. 62*, 1475 (1958) Dec. (5 pp.)

Formation of ammonia in mixtures of nitrogen and hydrogen exposed to cobalt-60 γ-radiation has been studied at gas pressures up to 100 atm. Ammonia concentration increases linearly with dose, the rate depending on the first power of the partial pressure of nitrogen. Rate also depends on the first power of the partial pressure of hydrogen at low pressures, but becomes independent as the partial pressure of hydrogen is increased. In a radiation field of 3.4×10^5 r./hr. at a nitrogen partial pressure of 34 atm, the rate of ammonia production increases with increasing hydrogen pressure to 1.2×10^{-5} mole/l.-hr at about 14 atm, and then remains constant as the hydrogen pressure is further increased.

Catalysts

Catalytic Vapor-Phase Oxidation of Xylenes. S. K. Bhattacharyya and I. B. Gulati. *Ind. Eng. Chem. 50*, 1719 (1958) Dec. (26 pp.)

Several supported and unsupported single, binary and ternary catalysts containing vanadium, molybdenum, tin, silver, copper, cobalt, uranium and cerium were tested for their comparative efficiency in catalyzing vapor-phase oxidation of *o*-, *m*-, and *p*-xylenes. Optimum operating conditions were established for all active catalysts. Best catalyst was found to be fused vanadium pentoxide; oxidation efficiency was most marked in the case of *o*-xylene, of which nearly 62% could be converted to phthalic anhydride. Maleic anhydride was main oxidation product of *m*- and *p*-xylenes. This is first systematic attempt to provide data on catalysts for oxidation of individual xylenes to industrially important products.

The Thermal Conductivity of Catalyst Particles. R. A. Sehr. *Chem. Eng. Sci. 9*, 145 (1958) Nos. 2/3 (8 pp.)

Three different methods for measurement of thermal conductivity of catalyst particles have been developed and are compared using silica-alumina cracking catalyst. Values of the thermal conductivity of a number of practical catalyst particles also are reported.

Coal Carbonization

Progress Review No. 46: Coal Carbonization—Coke-Oven Practice. C. W. Wood. *J. Inst. Fuel 31*, 541 (1958) Dec. (7 pp.)

Review of major advances since publication of the 1950 review. During this period there has been considerable expansion of the industry, coupled with rebuilding of older plants. In 1957, total weight of coal carbonized in coke ovens in Great Britain was 30.7 million tons compared with 23.6 million tons in 1951.

Gasification

Experiments with a Slagging Pressure Gasifier. D. Hebden and R. F. Edge. G. C. Communication No. 50. *Gas World 148*, 967 (1958) Nov. 22 (3 pp.); *Gas J. 296*, 472 (1958) Dec. 10 (6 pp.); *Gas Times*

92, 31 (1958) Dec. (2 pp.) **Discussion.** *Gas World 148,* 1020 (1958) Nov. 29.

Lurgi process is suitable for gasification of weakly caking coals that comprise about 50% of the total coal mined in Great Britain. By operating under pressure, it enables high outputs to be obtained from small coal, facilitates purification of the gas and makes the gas available for long-distance transmission without added compression charges. Since the main constituent is hydrogen, gas can be enriched by using it to hydrogenate oil, and it also can be used to upgrade the byproducts obtained.

Hydrogasification

Hydrogenation of Light Distillate and Production of Hydrocarbons. L. A. Moignard and K. D. Stewart. G. C. Communication No. 51. *Gas World 148,* 972 (1958) Nov. 22; *Gas J. 296,* 432 (1958) Dec. 3 (5 pp.); *Gas Times 92,* 56 (1958) Dec. (2 pp.). **Discussion.** *Gas World 148,* 1075 (1958) Dec. 6 (2 pp.)

It has been known for some time that hydrocarbon-rich gas of calorific value up to about 850 Btp/CF can be produced by the pressure hydrogenation of paraffinic light petroleum distillate at temperatures above 700° C; then, about 5 gal of distillate are required per 1000 CF of hydrogen, and conversion to gaseous hydrocarbons is almost complete.

Kinetics

Catalyst Kinetics in the Hydrocarbon Synthesis Reaction. C. G. Frye, H. L. Pickering and H. C. Eckstrom. *J. Phys. Chem. 62,* 1508 (1958) Dec. (6 pp.)

In investigating the reaction kinetics of hydrogenation of carbon monoxide over an iron base catalyst to form hydrocarbons and oxygenated hydrocarbons, it was observed that changes in operating conditions changed the surface quality of the catalyst and that this change was reversible. When the operating conditions were changed, a corresponding change in the reaction rate occurred. However, the reaction rate continued to change until it approached a steady-state value some time later. Thus, the observed kinetics is a combination of the ordinary reaction kinetics and the kinetics associated with change in catalyst surface quality.

Ore Reduction

Direct Iron Ore Reduction. P. E. Cavanagh. *J. Metals 10,* 804 (1958) Dec. (6 pp.)

Previous conclusions regarding impracticability of direct reduction of iron ore are being reversed. Reason appears to be largely economic: rising scrap costs and high cost of new capital equipment. Another factor stems from increasing availability of lower grade ores and necessity for treating fines; this means higher capital and operating costs associated with the classical blast furnace. At present, a number of direct reduction processes are under intensive investigation and four commercially operating proven processes for which production data are available. These processes offer a wide choice of method, and each is particularly suited to a definite set of conditions.

A New Direct Reduction Method. M. J. Udy and M. C. Udy. *Metal Progress 74,* 92 (1958) Dec. (3 pp.)

Partial reduction of ore by soft coal in a rotating kiln, followed by smelting in an electric furnace, produces iron for further refining. Carbon can be controlled in a 0.2-3.5% range and no special ore preparation is needed.

The Reduction of Barytes with Hydrogen. I. Kinetic Studies in a Differential Reactor. R. V. Culver, C. J. Hamdorf and E. C. R. Spooner. *J. Appl. Chem. 8,* 810 (1958) Dec. (10 pp.)

Reduction of barytes by H_2 has been studied at 800°, 900°, 1000° and 1100° in a differential reactor. Reaction rate is markedly temperature-dependent; it is accelerated by the presence of iron and siliceous impurities in the barytes, but is relatively insensitive to variations in the partial pressure of H_2 due to the presence of N_2 or water vapor. Available evidence suggests that the rate of reduction is chemically controlled and that the reaction occurring at the $BaSO_4$-BaS interface depends upon the presence of defects in the $BaSO_4$ lattice. Empirical equation is developed for experimental rate data at 1100°, use of which may be of value in design work.

The Reduction of Barytes with Hydrogen. II. Kinetic Studies in Fixed and Fluidized Beds. R. V. Culver, C. J. Hamdorf and E. C. R. Spooner. *J. Appl. Chem. 8,* 820 (1958) Dec. (8 pp.)

Barytes were reduced in thick beds, both fixed and fluidized. For +14-10 mesh barytes reduced at 1100°, the reaction rate in a fixed thick bed was predicted from data obtained in a differential reactor; in a fluidized bed, maximum reaction rate observed was 26×10^{-2} g of $BaSO_4$/min. g and values of the coefficient of mass transfer between the continuous and discontinuous phases of the fluidized bed were calculated on the basis of the two-phase theory of fluidization. For +14-10 mesh barytes reduced at 1000°, the performance of a fixed thick bed fell considerably below that obtained in a differential reactor; the action rate in a fluidized bed was favored by high gas flow rates and shallow beds and the data suggest that the reaction rate was depressed by the presence of reduction process products. In the case of +65-48 mesh barytes reduced in a fluidized bed at 900° and 1000°, the H_2 supplied to the reactor

was utilized effectively only at the higher temperature, which gave up to 37% utilization.

Reformed Gas

Experiences with Refinery Gas at Southampton. W. F. Thorne, R. K. Harrison and J. R. Fairman. I. G. E. Communication No. 536. *Gas World 148,* 963 (1958) Nov. 22 (4 pp.); *Gas J. 296,* 437 (1958) Dec. 3; *Gas Times 92,* 46 (1958) Dec. (2 pp.). **Discussion.** *Gas World 148,* 1018 (1958) Nov. 29.

Use of refinery gas from the Fawley refinery of the Esso Petroleum Company, Ltd., by the Southern Gas Board was the first of its kind in the United Kingdom. Description of planning of project, the contract, the refinery gas main from Fawley to Southampton, conversion of water gas plants for reforming, installation of catalytic-gasification plants and other uses for refinery gas.

Shale Oil

Spain Finds Shale Oil Profitable. *Petrol. Weeks 7,* 24 (1958) Dec. 26 (2 pp.)

Empresa Nacional "Calvo Sotelo" company has invested through INI, the Reconstruction Finance Corp. of Spain, about $110-million for the exploitation of Spanish oil shale deposits. About $60 million of this amount will be spent on the mining-retorting-distillation-packaging installation centered around the Puertollano oil-shale deposits, 135 miles south of Madrid. Research for the development of new products is conducted in Madrid.

Sulfur Oxides

Catalytic Oxidation of Sulfur Dioxide at Low Concentrations. D. H. Napier and M. H. Stone. *J. Appl. Chem. 8,* 781 (1958) Dec. (6 pp.)

Suggested process for removing sulfur oxides from boiler flue gases requires as a first stage the oxidation of sulfur dioxide to sulfur trioxide, followed by the removal of sulfur trioxide as ammonium sulfate or sulfuric acid. Only work on the first stage is reported. Bench-scale experiments with simple apparatus were conducted to examine catalytic oxidation of sulfur dioxide in flue gases. Four vanadium pentoxide catalysts of differing composition were compared, and the best was used in a brief study of contact time, sulfur dioxide concentration and oxygen concentration. Results suggest that it might be technically feasible to oxidize the sulfur dioxide in flue gases, and that normal variations in flue gas composition would have little effect on the reaction.

Water Gas

Kinetics of Water-Gas Conversion Reaction. P. Bortolini. *Chem. Eng. Sci. 9,* 136 (1958) Nos. 2/3 (10 pp.)

Description is given of experimental investigations into kinetics of water-gas conversion reaction as a function of gas composition and its specific flow-rate. Results obtained are compared with calculated reaction rate, assuming that mechanism determining kinetics of the process as a whole is diffusion of gas reagents in catalyst surface and of catalysis products in the gas. It is found that, at least at temperatures of about 500° C and higher, this diffusion mechanism actually does determine kinetics of the entire process. For experimental purposes, reactions of oxidation and reduction occurring between the gas and the catalyst also were studied as a function of the temperature and the H_2O: CO ratio. Useful data are derived for the design and the operation of commercial reactors.

Acetylene

Process of Interacting Hydrocarbons with Oxygen. E. Bartholome, E. Lehrer, H. Nonnenmacher and O. Frey (assigned to Badische, Anilin- & Soda-Fabrik, AG). U.S. 2,862,984 (1958) Dec. 2.

In the production of acetylene by incomplete combustion of methane and oxygen, premature reaction in the burner mixing zone is stopped by injecting into the mixing zone a short blast of nitrogen of 40-100% of volume of the oxygen.

Carbonization

Carbonization of Agglomerative Coals. I. H. Welinsky (assigned to Consolidation Coal Co.) Re. 24,574 (of U.S. 2,677,650). (1958) Dec. 9.

Multiple vessel fluidized carbonizing process is claimed in which outgoing product is divided into product, preheat, and carbonizing portions by withdrawing the first, sending the second to a mixing vessel to be added to incoming coal and sending the third portion to a burning vessel in which combustion raises the bulk of it to 850-1800°F, which then is added to carbonization vessel as a heating medium.

Coal Hydrogenation

Balanced Hydrogenation of Coal. M. G. Pelipetz (assigned to U.S.A.) U. S. 2,860,101 (1958) Nov. 11.

Direct hydrogenation of coal in a single stage is claimed, which comprises mixing the pulverized coal with catalyst and pasting oil, reacting with H_2 for 15 sec—15 min at up to 500°C and 475 atm, cooling conversion effluent, separating fixed gases, distilling liquid product to 200°C for aromatic light gasoline product and returning most heavier oil residue as pasting oil. Hydrogen is provided by steam reforming of reactor off-gases.

Ethylene

Recovery and Use of Olefins and Hydrogen Sulfide in Gases. C. S. Kelley (assigned to Phillips Petroleum Co.) U. S. 2,861,113 (1958) Nov. 18.

High purity ethylene gas and a propylene alkylate are produced from cracked hydrocarbon gas by reacting olefine-bearing gas mixture with contained (or added) H_2S over a bauxite catalyst, oil scrubbing to remove ethyl and propyl mercaptans and scrubbing overhead gases to produce a purified fuel gas. Mercaptans are fractionated from rich oil to yield ethyl mercaptan, which is decomposed on catalyst to give ethylene and H_2S, and propyl mercaptan which is reacted with added *iso*-butane to form an alkylate motor fuel and H_2S, both steps returning the H_2S to recycle.

Sulfur Oxides

Treatment of Flue Gases. W. D. Burgess (assigned to Consolidated Mining and Smelting Company of Canada Limited). U.S. 2,862,789 (1958) Dec. 2.

Stream of hot combustion gases from high sulfur fuels is contacted with cool aqueous ammonium sulfate solution from a previous step, whereby sulfur dioxide is removed from the solution and water also is evaporated. Ammonium sulfate then is crystallized from the solution. The cooled gas, with water vapor and SO_2, then is contacted with a solution of ammonium sulfites containing added ammonia whereby SO_2 is absorbed from the cooled gas which is discharged. A portion of this circulating solution is withdrawn and acidified with sulfuric acid, whereby SO_2 is evolved and dilute ammonium sulfate is formed, which solution is returned to the first-mentioned cooling step.

Synthesis Gas

Synthesis Gas Reactor and Heat Exchanger. J. L. Oberg (assigned to The Babcock & Wilcox Co.) U.S. 2,862,480 (1958) Dec. 2.

Synthesis gas generator operating on methane and oxygen is claimed, with a lower refractory-lined combustion zone and an upper tube-nested annular heat exchanger, both enclosed within a pressure vessel. Annular tube-nest elements are welded adjacently to form a wall between inner and outer annular passes, and are connected to upper and lower ring headers, with the product gas passing through the tube banks to a dome and a top outlet.

8. GAS DISTRIBUTION

Distribution Systems

Development at an Integrated Iron and Steel Works and a Gas Grid Supply Station Using Coke Oven Gas. J. T. Davies, W. F. Edwards, W. D. Rees and H. J. Victory. *Gas World 148,* 1026 (1958) Nov. 29 (5 pp.); *Gas Times 92,* 62 (1958) Dec. **Discussion.** *Gas World 148,* 1123 (1958) Dec. 13 (4 pp.)

Examination of developments at the Steel Company of Wales' works resulting in large-scale supplies of coke oven gas being made available to the gas industry locally. Increase in such supplies flowing from the major development of the Steel Company of Wales, and the acceptance thereof commercially and technically by the Port Talbot gas undertaking, at pace with the development, is shown. Early history of challenging pioneer efforts to utilize coke oven gas locally and the following successful—albeit small-scale—beginnings are described in a brief historical record.

Leakage

A Case Report on System Conditioning. D. M. Ballou. *Gas Age 122,* 25 (1958) Dec. 11 (3 pp.)

Plan used by Holyoke, Mass., Gas & Electric Dept. includes internal sealing by spray, bell joint clamping, main and service renewals and annual four-point condition checks. Reduction in unaccounted-for and increased pressure safe limits have been obtained; eventual increase to intermediate pressure throughout system will be possible.

Mains

Sealing Pipe Joints by the Internal Spring Band Method. C. P. Xenis and D. Hale. *Am. Gas J. 185,* 17 (1958) Dec. (3 pp.)

New technique developed by Consolidated Edison (N. Y.) utilizes spring steel bands, aluminum foil and black plastic sealing material. On basis of experience to date with pipe sizes ranging from 30-48 in., costs of repairing and sealing joints have been reduced from one-half to two-thirds over other methods. So far, the company has used this method for 742 joints on 30-in. cast iron mains, 12 joints on 36-in. mains, 526 joints on 42-in. mains and 1482 joints on 48-in. mains.

Maintenance

Air Power Helps Laclede Improve, Expand Gas Service. *Am. Gas. J. 185,* 22 (1958) Dec. (3 pp.)

Spectacular growth of Laclede Gas Company (St. Louis) has imposed a serious burden on maintenance and construction departments. To speed work and help make best use of manpower skills, the St. Louis utility uses compressors and a wide variety of air tools for emergency leak repairs, programmed maintenance of old mains, service connections and installation of new mains.

Metering

Meter and Regulator Problems in Changeover to Natural Gas. H. J. Evans. *Gas Age 122*, 41 (1958) Dec. 11 (3 pp.)

Problems encountered with meter and regulators in changeover to natural gas correlate with the original condition of the system and the method used in keeping the system in good operating condition after the changeover.

Odorization

Odour and Odorization of Gas. K. A. Deadman and J. A. Prigg. G. C. Communication No. 59. *Gas World 148*, 983 (1958) Nov. 22; *Gas Times 92*, 48 (1958) Dec.; *Coke and Gas 20*, 506 (1958) Dec. (2 pp.). **Discussion.** *Gas World 148*, 1076 (1958) Dec. 6 (2 pp.)

Brief review of the sense of smell and methods of assessing odor intensity, with a description of an odorimeter for comparing odor intensities of gases. Odor intensities of some of the constituents of conventional gases have been examined to determine compounds responsible for the characteristic odor of these gases. Investigation of relative odor strengths of some gases now being produced has been conducted to establish the level to which gases with insufficient odor must be odorized for distribution. Properties required in a gas odorant are discussed and laboratory and field tests on some materials as possible odorants are described.

Pressure Regulation

Gas Pressure Regulation in Gas Distribution Systems. L. deJong. *Gas- u. Wasserfach 99*, 1201 (1958) Nov. 21 (10 pp. German text.)

Pressure regulating devices and installations are discussed in some detail from the standpoint of the DVGW rules presented in March, 1957, to cover such equipment. Several installations for house, industrial, district and city supply at various pressures are described with diagrams and illustrations. Construction, ventilation, safety, metering and piping practice and costs are mentioned.

9. GAS FUEL UTILIZATION AND APPLIANCES

Air Pollution

Atmospheric Pollution: The Role Played by Combustion Processes. E. S. Grohse and L. E. Saline. *J. Air Pollution Control Assoc. 8*, 255 (1958) Nov. (13 pp.)

Problems of air pollution from combustion processes should be solvable in a relatively straightforward manner by application of measures such as those which proved so successful in formerly critical areas of St. Louis and Pittsburgh. These measures include prohibition or controlled usage of high volatile fuels; washing of solid fuels to remove high sulfur refuse; promotion of more efficient combustion; reduction of industrial emissions; dieselization of railroad locomotives; control of smoke from diesel engines; change-over from high-sulfur coal to oil or gas as fuels; elimination of burning at public dumps and minimization of private incineration. It is believed that problems of sulfur dioxide emission to the atmosphere will tend to become alleviated automatically in the course of restricting emission of smoke and dust. Toxicity of below "normal" tolerance level concentrations of sulfur dioxide is attributed to soluble sulfur salts which result from chemical combination of sulfur dioxide with metallic compounds present in atmospheric dusts.

The Deterioration of Materials in Polluted Atmospheres. J. E. Yocom. *J. Air Pollution Control Assoc. 8*, 203 (1958) Nov. (6 pp.)

Deterioration of materials resulting from atmospheric pollution is a serious economic loss. Beyond this, it is related to a number of complex atmospheric and surface reactions, all of which could use further study. Atmospheric corrosion engineers and specialists who must investigate deterioration of materials need to familiarize themselves thoroughly with the physical environment in which they carry out their measurements. This knowledge includes not only physical factors which influence the form and manner in which the agent contacts the materials, but also knowledge of the chemistry of specific agents which singly or in combination lead to ultimate damage to materials.

Some Factors Affecting the Concentration of Oxides of Nitrogen in Exhaust Gases from Spark Ignition Engines. G. J. Nebel and M. W. Jackson. *J. Air Pollution Control Assoc. 8*, 213 (1958) Nov. (7 pp.)

Independent effects of air-fuel ratio, spark timing, manifold air pressure and compression ratio on the concentration of oxides of nitrogen in exhaust gases were studied. Air-fuel ratio was found to be most important variable. Maximum concentrations of oxides of nitrogen were formed when the air-fuel ratio was one to three ratios leaner than stoichiometric. Lowest concentrations, often only 1% of maximum values, were found at the richest air-fuel ratios tested. Two possible methods to reduce emission of oxides of nitrogen from automobiles are

pointed out. These involve modifications of carburetion or spark timing.

Burners

Combustion Noise. J. K. Kilham and T. J. B. Smith. G. C. Communication No. 49. *Gas World 148*, 982 (1958) Nov. 22 (2 pp.); *Gas Times 92*, 57 (1958) Dec. (2 pp.). **Discussion.** *Gas World 148*, 1087 (1958) Dec. 6.

Problem of burner noise is important to the gas industry since about 15% of the gas manufactured is used industrially in noisy equipment. The proportion is likely to increase in the future with more widespread use of high-velocity tunnel burners for local-heating operations.

The Design of Air Blast Tunnel Burners. W. E. Francis. G. C. Communication No. 48. *Gas World 148*, 966 (1958) Nov. 22 (2 pp.); *Gas Times 92*, 45 (1958) Dec. (2 pp.). **Discussion.** *Gas World 148*, 1080 (1958) Dec. 6 (2 pp.)

Practical aspects of improved designs of tunnel burners described have been studied from the point of view of stability, ignition and flame-failure protection, shaped exit nozzles and operation with preheated air. Complete burner dimensions are given for the construction of a range of burner types of improved pressure efficiency. Optimum lengths of tunnel and mixture tube together with air nozzle-mixture tube spacing have been determined experimentally, and preliminary results of a study of the effect of burner length and tunnel material on noise production are reported.

Gas Immersion Burners Aid in Fire Protection. K. E. Schneider. *Ind. Gas 37*, 13 (1958) Dec. (2 pp.)

Philco Corp. keeps 150,000 gal. standby water for fire protection at 40°F throughout the winter. Heating system automatically supplies heat when water temperature drops below 40°F, and needs no attendant—nor maintenance.

Flame Research

Concerning a Method for Determining the Turbulent Speed of Propagation of a Flame. K. P. Vlasov. *Appl. Mech. Rev. 11*, 703 (1958) Dec. (From *Soviet Phys.-Tech. Phys. 2*, 303 (1958) Feb. (6 pp. Russian text.))

Author describes use of double probe (ionization) for determination of turbulent flame velocity. He compares ionization with optical method for establishing instantaneous flame-front position, and points out relative ease with which statistically useful data can be obtained from ionization probe. Author favors statistical treatment of short-duration measurements rather than self-averaging measurements (thermocouple or long-exposure photography) in the location of the turbulent flame front, because the averaging method in the statistical case is known and controllable.

J. S. Arnold, USA

Energy Transfer from Flames. G. Dixon-Lewis. G. C. Communication No. 58. *Gas World 148*, 978 (1958) Nov. 22; *Gas Times 92*, 39 (1958) Dec.

Mechanism of energy transfer from flame gases to a solid body immersed in them is discussed. This energy transfer usually occurs chiefly by forced convection, but in some circumstances forced convection does not account for the whole of the energy transfer. In order to account for the residual energy transfer, the thermodynamic and kinetic aspects of the equilibria in the burnt gases are considered, both for the free flame and at the solid surface.

The Ignition of Combustible Mixtures by Hot Gases. H. G. Wolfhard. *Jet Propulsion 28*, 798 (1958) Dec. (7 pp.)

Fuel-air mixtures are ignited by a jet of hot gases which is heated in a ceramic furnace. Igniting gas is continuously injected into the cold explosive mixture. Luminous reactions can be observed to occur in the center of the hot jet if its initial temperature approaches a critical temperature. On further raising the temperature of the jet, the luminosity increases and a laminar luminous pencil extends up to 30 cm above furnace exit. A flame then can be seen to originate from the top of this column and propagate into the cold mixture outside. Two types of experiment are performed: ignition of cold fuel-air mixtures by hot neutral gases, such as nitrogen or carbon dioxide; and ignition of cold fuel by hot air. In the second case only a diffusion flame can be ignited which, under favorable conditions, floats on top of the hot air jet. These "hot gas ignition temperatures" bear little relation to the "spontaneous ignition temperatures."

Influence of Approach Boundary Layer Thickness on Premixed Propane-Air Flames Stabilized in a Sudden Expansion. W. T. Snyder. *Jet Propulsion 28*, 822 (1958) Dec. (4 pp.)

In this investigation, effect of approach boundary layer on flame stabilization was studied. In particular, a Reynolds number range of 1.5×10^5 to 8.65×10^5 was considered. It was noticed that decreasing the boundary layer thickness at the flameholder decreased the maximum blowoff velocity and the range of stability curves while shifting them in the direction of richer mixtures.

The Reaction of Hydrogen Atoms with Carbon Dioxide at 1200-1350°K. C. P. Fenimore and G. W. Jones. *J. Phys. Chem. 62*, 1578 (1958) Dec. (7 pp.)

When burnt at low enough temperatures on a cooled porous burner, rich, premixed flat flames of hydrogen, oxygen and carbon dioxide give a post flame gas containing too much carbon dioxide and hydrogen to correspond to the water gas equilibrium. By sampling the gas at a number of positions, one can observe the decay of carbon dioxide and hydrogen as the burnt gas moves downstream. Concentration of hydrogen atoms can be determined simultaneously by adding a little heavy water to the reactants and measuring the rate of formation of HD in the products.

Recent Advances in Determination of Radiative Properties of Gases at High Temperatures. J. G. Logan, Jr. *Jet Propulsion 28,* 795 (1958) Dec. (4 pp.)

Fundamental knowledge concerning internal structure of gas molecules, collision phenomena, reaction rates and relaxation processes formerly supplied primarily by studies of radiation of electrical discharges and combustion processes now is being greatly extended through use of shock tube facilities for generation of high gas temperatures under controlled density and temperature conditions. Information derived from these studies is making a significant contribution to solution of problem of radiation from high temperature gases in thermal equilibrium. Bibliography cited includes 52 items.

Gas Turbines

Combining the Gas Turbine and the Steam Turbine. A. O. White. *Mech. Eng. 80,* 48 (1958) Dec. (6 pp.)

Supercharged-boiler cycle gives a larger gain in thermal efficiency than any other step in steam power plants that can be foreseen, at a capital cost per kilowatt that is comparable to that for a conventional steam plant. It is an eminently practical cycle for those areas that have an adequate supply of natural gas, and its ability to burn the other low-cost fuels is certain to come in time. Such a plant should be placed in service to prove the principles and obtain operating experience.

Heat Treating

Controlled Atmospheres for Metallurgical Processes. I. L. S. Golding. *Gas World 148,* 122 (Ind. and Commercial Gas Sect.) (1958) Dec. 24 (5 pp.)

Gas carburizing is carried out in either batch or continuous type furnaces, and is an ideal treatment for gears and other parts where a tough core protected by a hard wear-resistant shell is required. Case depth and hardness are varied to meet different requirements by controlling the temperature and time of carburizing and the hydrocarbon content of the gas. Several methods are available for production of carburizing atmospheres. It is essential that these contain a carburizing constituent, generally a hydrocarbon of low molecular weight, although very high percentages of carbon monoxide will suffice in some instances. Frequently a carrier gas of carbon monoxide, hydrogen and nitrogen is prepared and used as a diluent for the hydrocarbon. Water vapor and CO_2 must be excluded from the atmosphere.

Heat Treatment of Aluminum. (Effect of Heating Method and Furnace Atmosphere.) H. M. Short. *Ind. Heating 25,* 2432 (1958) Dec. (7 pp.)

Investigational work has been performed at Alcoa Research Laboratories to evaluate influence of various atmospheres on aluminum and its alloys at elevated temperatures. In addition, work was performed cooperatively with the Michigan Consolidated Gas Company, results of which have been published. Tabular data and micrographs of polished cross sections of samples originally published are reproduced in this article. The work was performed on a copper alloy, then designated as 24S, now identified as 2024 alloy.

No Waiting in this Heat Treat Line. L. H. Everitt and C. C. Sykes. *Metal Progress 74,* 74 (1958) Dec. (6 pp.); **Automatic Heat Treating in Roller Bearing Manufacturing.** L. H. Everitt and O. E. Cullen. *Ind. Gas 37,* 9 (1958) Dec. (4 pp.)

Heat treating department at the Columbus, Ohio, plant of Timken Roller Bearing Co. functions as a single machine to automatically process five standard lines of railroad roller bearings. Equipment includes two gas carburizers, one high-temperature tempering furnace, four combination "wash-rinse-dry" machines, one reheating furnace, two quench presses and one low-temperature tempering furnace. Units are tied togetherd by a handling system.

Industrial Heating

Submerged Evaporation and Its Application to Fish Stickwater Recovery. G. A. Carpenter. *Chem. & Process Eng. 39,* 425 (1958) Dec. (4 pp.)

Brief review of scope and historical development of submerged evaporation and discussion of its application to recovery of fish stickwater. Details of experiments connected with novel application are given. It is concluded that further tests are desirable regarding quality of solubles, and air pollution by odors. Use of a submerged evaporator is particularly advantageous for a short operating season because of its low first cost and reasonable thermal efficiency.

Textiles, Air and Gas. J. Sellors, Jr. *Ind. Gas 37,* 6 (1958) Dec. (5 pp.)

Application of heat to textile processing can be considered as application of hot air. It is hot air in suf-

ficient volume under optimum velocities at proper temperature level which does require processing of the fabrics. Wide variety of methods of using heated air in many textile operations was discussed at Textile Processing Symposium. This article discusses some of the methods of producing this hot air under controlled conditions at exactly the temperature level required.

Interchangeability

Carbon Index of Fuel Gases and Their Practical Application. C. Padovani and E. Caffo. *Rivista dei Combustibili 12*, 725 (1958) Oct. (22 pp. Italian text.)

Carbon index (volume of carbon dioxide produced by complete combustion of one volume of gas) is a typical characteristic of fuel gases that can be relatively easily assayed experimentally. There is a correlation between the mean carbon index and some chemical and physical properties of gaseous hydrocarbon mixtures. This correlation is approximate for the calorific value and relative density; for theoretical air and theoretical combustion fumes the correlation is exact. The hydrocarbons considered were the gaseous hydrocarbons of the methane and ethylene series. In particular it is shown that the carbon index may be applied to determine the correlation coefficients due to the presence of the higher hydrocarbons which Delbourg introduced into his latest interchangeability formulae to correct the Wobbe index and combustion potential. In these cases, as well as for calculating the soot index of ventilated or non-ventilated flames, computation on the basis of the carbon index is notably more precise than the methods proposed by Delbourg.

Nitrogen Oxides

System Designs for the Catalytic Decomposition of Nitrogen Oxides. J. L. Donahue. *J. Air Pollution Control Assoc. 8*, 209 (1958) Nov. (5 pp.)

In the catalytic reduction of nitrogen oxides, no effort has been made to determine the influence of pressure on the reaction rate. Emphasis on existing installations has been placed on correction of toxic and corrosive hazards associated with industrial off-gas containing exceedingly high concentrations of nitrogen oxides. Experimental installations are now being conducted where nitrogen oxide concentrations entering the system are expected to be less than 200 ppm. When a widely accepted method for testing and analysis is available, it is expected that data on the catalytic reduction of low concentrations can be offered.

Refrigeration

Ejector Refrigeration from Low Temperature Energy Sources. J. Mizrahi, M. Solomiansky, T. Zinser and W. Resnick. *Appl. Mech. Rev. 11*, 696 (1958) Dec. (From *Bull Res. Council Israel* 6C,1 (1957) Nov. 8 pp.))

Calculations have been carried out to determine feasibility of operating an ejection refrigeration system with a low-temperature energy source such as that available from simple solar collectors or exhaust steam. Calculations were based on data previously reported for a commercial ejector. With an evaporator temperature of 5° F, a condenser temperature of 86° F and a heat source at 140° F, the refrigerants, propane, Freon-22 and Freon-12 had performance factors of the order of 0.2. Curves are presented to show effect of changes in operating temperatures on the performance factor. Calculations indicate that an ejector refrigeration system would appear to be a feasible method for producing refrigeration from low-temperature energy sources.

From authors' summary

Ventilation

For the Architect and Builder. Gas *21*, 12 (1958) Dec. (2 pp.)

Gas industry development of considerable interest to architects and builders is Se-Duct flue systems. Advantages are: 1) flexibility; 2) reduced building costs; 3) substantial increase in lettable space; 4) fully comprehensive heat service with advantage that running costs remain directly under the control of each individual tenant; 5) installation of 75-80% efficiency 'room sealed' gas appliances at lowest cost; 6) higher operational standard of both space and water heating at reduced operating costs, and 7) significant reduction in cost of each gas appliance.

Further Experiments with Flues for Gas Appliances. W. J. Bennett, K. J. D. Brady and E. W. G. Dance. G. C. Communication No. 53 *Gas World 148*, 976 (1958) Nov. 22; *Gas Times 92*, 41 (1958) Dec. (2 pp.)

Progress report covering a two-year period on the study of flues for gas appliances. In one section, determinations of thermal transmittance values on a range of flues of various sections and materials are described, and also measurements of the resistance factors of a number of bends and terminals. Another section gives an account of the field tests on three branched-flue installations, two at Westminster venting water heaters and one for gas fires at West Ham.

Water Heating

Immersion Tube Heating of Aqueous Liquids. E. A. K. Patrick and E. Thornton, G. C. Communication 47. *Gas Times 92*, 34 (1958) Dec. (2 pp.). **Discussion.** *Gas World 148*, 1084 (1958) Dec. 6.

Two main results have emerged from a survey initiated to discover what performance, as measured by

thermal efficiency, is obtained from immersion tube heating installations under district (North Thames Gas Board) conditions, and to attempt to reconcile values obtained with those predicted by use of equations arising from reported laboratory researches. First result is the separation of design procedure into two distinct stages: 1) Tube diameter is first selected on grounds concerned entirely with combustion considerations; 2) selected diameter and desired efficiency are then used to determine effective length of tube required. Second result is clear picture of four aspects of problem on which further research is required: 1) Appropriate value of corrected length; 2) refinement and further development of theoretical analysis; 3) full analysis of results of research program being conducted at Battersea, and 4) study of factors governing choice of tube diameter.

Burners

Apparatus for Causing Intermittent Combustion of a Fuel in a Chamber as a Means of Producing Useful Energy. P. Schmidt. U. S. 2,860,484 (1958) Nov. 18.

Useful mechanical or thermal energy is obtained from intermittent combustion in a chamber with controlled inlet whereby air is introduced in a timed sequence to form a combustion mixture at the inlet just as the pressure wave from the previous explosion returns through the annular casing and while a low pressure prevails in the inlet chamber of the burner.

Burner Apparatus. W. H. Dailey, Jr. (assigned to Surface Combustion Corp.) U. S. 2,861,629 (1958) Nov. 25.

Wall burner is claimed in which gas is fed through four fuel tubes in which helical vanes impart a clockwise whirling motion to two streams and a counterclockwise motion to the other two, the gas mixing with an annular flow of air at the burner port.

10. EQUIPMENT AND INSTRUMENTATION

Analytical Instruments

Analytical Instrumentation Problems in Radiochemical Processes. R. C. Axtmann. *Control Eng. 6,* 94 (1959) Jan. (4 pp.)

Processes that involve radioactivity pose an interesting array of new control problems. With the approach of economical nuclear power and increased use of radioisotope tracer techniques, process control engineers will find solutions to many of these problems in the application of automatic analytical instruments. Author discusses some of the principal radiochemical processes, variables to be measured and controlled, and problems encountered by instrument designers.

Polarography of Gases. Quantitative Studies of Oxygen and Sulfur Dioxide. D. T. Sawyer, R. S. George and R. C. Rhodes. *Anal. Chem. 31,* 2 (1959) Jan. (4 pp.)

Polarographic behavior of a large number of gaseous materials is subjected to exploratory investigation. Half-wave potentials and diffusion currents are determined for most of the gases. Quantitative method is developed for determining oxygen and sulfur dioxide in the gas phase as well as in solution.

Determining Molecular Structure by Nuclear Magnetic Resonance of Hydrogen. N. F. Chamberlain. *Anal. Chem. 31,* 56 (1959) Jan. (22 pp.)

Rapid and accurate method for determining structural features of hydrocarbons and their derivatives in pure form or mixtures is presented. Technique employs nuclear magnetic resonance spectrometry of hydrogen and is used to identify starting compounds, reaction intermediates and products of organic reaction.

Automation

Free Hand for Sun's Automaters. *Business Week 1532,* 45 (1959) Jan. 10 (3 pp.)

Staffs are reorganized to spur renovation of oil company's older plants, with fuller use of automation for efficiency. Company has turned over to a small group of scientists and other specialists the major responsibility for keeping its refineries operating at optimum efficiency. Staff has been delegated with broad responsibility, including elimination of jobs. Eventual objective is to employ pushbutton control of entire processing plants within its refineries.

Computers

Fitting Gas Measurement Calculations Data to Punch Card. H. G. Morris. *Pipe Line News 30,* 27 (1958) Dec. (7 pp.)

Use of punch cards and electronic computers has advanced calculation and statement preparation in last few years. Advantages of method are increased accuracy and a manifold increase in speed with which calculations, volume statements, billing and payments are made. Market offers several brands of electronic computers with wide range of applications and costs.

Fractionation

Estimate Cost of Fractionation Systems. I. Bromberg. *Petrol. Refiner 37,* 141 (1958) Dec. (3 pp.)

Thirty different fractionation systems were compiled

to provide data for cost generalizations given in this article. Review of four typical systems described indicates how data were obtained.

High-Temperature Techniques

Intense Arc Pierces Temperature Barrier. *Chem. Eng. 65,* 24 (1958) Dec. 29 (3 pp.)

Producing temperatures at the 15,000-30,000°F level, the high-intensity electric arc opens a completely new environment that engineers are now exploiting. Using this tool, engineers decompose or combine at ultra-high temperatures materials whose molecules are unreactive below 10,000°F; spray-coat surfaces with refractory materials; fuel space vehicles with metals to be ionized and magnetically thrust from a space vehicle's propelling chamber, and reproduce rocket re-entry conditions to test new materials of construction.

Piping

Costing Piping, the Bugaboo of Chemical Plant Estimating. H. C. Bauman. *Ind. Eng. Chem. 51,* 81A (1959) Jan. (3 pp.)

Estimating piping from flowsheets can save time and expense in preparing study and preliminary estimates. Method is simple: Take an average unit, estimate sizes of pipe required, probable length and known manpower costs. The figures can indicate probable cost of new installation.

Shell Gives Flexible Pipe Its Offshore Baptism in a Gulf Field. *Petrol. Week 7,* 30 (1958) Dec. 26 (2 pp.)

Shell Oil Co. is conducting tests at its South Pass (La.) production holdings in the Gulf of Mexico to determine whether flexible pipe is suitable for possible use in offshore oil operations all over the world. New pipe has a plastic core wrapped in heavy steel tapes and insulating materials. Pipe core is 3 in. in diam., and heavy tape wrapping, which does not lessen flexibility, brings the pipe's O.D. to 4½ in. Pipe is designed for a 2000-psi working pressure and weighs 12.2 lb/ft.

Temperature Measurement

Measurement of Gas Stream Temperatures in Industrial Appliances. P. G. Atkinson and J. R. Hargreaves. G. C. Communication 57. *Gas Times 92,* 40 (1958) Dec. (2 pp.); *Gas World 148,* 130 (1958) Dec. 20 (2 pp.)

Description of development of a water-cooled suction pyrometer suitable for higher temperatures (above 1100°C). Some details also are given of the work on a refractory pyrometer, the development of which was eventually discontinued in favor of a more robust instrument.

11. MATERIALS OF CONSTRUCTION, AND CORROSION

Cathodic Protection

Cathodic Protection and High Resistivity Soil—A Sequel. H. C. Van Nouhuys. *Corrosion 14,* 583t (1958) Dec. (5 pp.)

Additional information is given to supplement an earlier paper dealing with the installation and economic aspects of a 25-rectifier system used to provide solid protection along 350 miles of bare 8-in. pipe in ultra-high resistivity soil. Four basic types of leaks are discussed. Analysis of the leak record is made from data obtained at each leak location in an effort to properly allocate those leaks due to the inadequacy of the criterion as opposed to leaks resulting from rectifier downtime or other unusual causes. Total of 10 leaks which occurred during first five years of operation are considered. Summary is given of savings to be expected from application of method of design over other criteria as well as precautions to be taken in its use.

Criteria for Adequate Cathodic Protection of Coated, Buried or Submerged Steel Pipe Lines and Similar Steel Structures. NACE Tech. Unit Comm. T-2C on Criteria for Cathodic Protection. *Corrosion 14,* 561t (1958) Dec.

Criteria are given for adequate cathodic protection of coated, buried or submerged steel pipelines and similar structures. It was recommended that a protective electric current be applied to the structure in an amount sufficient to maintain its external surface, at every point, negative by at least 0.85 v to a copper-saturated copper sulfate half cell in the structure's immediate proximity. Three reservations regarding use of these criteria are incorporated into the recommendations.

Coatings

A Coating Evaluation Testing Program. E. R. Allen, Jr. *Corrosion 14,* 546t (1958) Dec. (7 pp.)

Program to test and evaluate external pipeline coatings is described. When program was initiated ten years ago, many methods and procedures then in use did not give all of the information desired. Field burial tests are lengthy and because of the variable conditions which govern results can neither be controlled or evaluated with any precision. Test program was in three phases: 1) Laboratory procedures and apparatus were developed; 2) commonly used coatings were tested and laboratory results correlated with field performance data, and 3) new materials were tested and their performance compared with coatings in common use. Laboratory and field test apparatus and procedures are described. Discussion

on application of test data to selection of pipeline coatings is included.

New Portable Taping Machine Speeds Small Pipe Wrapping in Minneapolis. *Am. Gas J. 185,* 20 (1958) Dec. (2 pp.)

Minneapolis Gas Co. is using new pipe taping machine to clean and wrap 135,000 ft of bare 1-in. and 1½-in. pipe in its storage yard. Pipe is fed into machine through cleaning heads—two wire brushes rotating at 4000 rpm—while entire assembly revolves around the pipe at 800 rpm. Pipe then enters driving mechanism and is held in position by a spring-loaded idler mounted above the driving rollers. Machine holds promise as being adaptable for use on the job in field operations.

Corrosion

Corrosion of Mild Steel in Aqueous Monoethanolamine. H. R. Froning and J. H. Jones. *Ind. Eng. Chem. 50,* 1737 (1958) Dec. (2 pp.)

Factors affecting chemical attack on mild steel by aqueous monoethanolamine solutions have been studied. These included temperature, presence of contaminants and concentrations of amine, carbon dioxide and hydrogen sulfide. Corrosion was more severe with high amine concentrations and at a given set of conditions increased with temperature. Hydrogen sulfide was most corrosive at low concentrations. Carbon dioxide was more corrosive than hydrogen sulfide and most corrosive at intermediate concentrations. When both were present, corrosion rate was largely determined by hydrogen sulfide concentration. Small amounts of soluble silica inhibit corrosion in carbon dioxide-amine systems. Service life cannot be predicted from these data alone as other variables contribute to localized attack.

Corrosion of Refinery Equipment During Acid Cleaning. K. R. Walston and A. Dravnieks. *Corrosion 14,* 571t (1958) Dec. (7 pp.)

Economical, effective and relatively easy to handle, hydrochloric acid is being widely used as a solvent for chemical cleaning of refinery equipment. Inhibitors must be added to retard corrosion during cleaning operations, but these inhibitors must not prevent dissolution of the scale to be removed. Practical temperature ranges for cleaning are given. Corrosion rate increases exponentially with temperature and with acid concentration. Corrosion rates of various metals in 5% inhibited hydrochloric acid are given. Influence of inhibitors on rates of dissolution of iron oxides and sulfides are shown. Four typical cases of corrosion occurring during acid cleaning are discussed with special safety precautions that should be observed during cleaning operations. Influence of commonly present substances such as hydrogen sulfide is shown to increase rate of corrosion.

Determining Corrosion Aggressiveness of the Atmosphere. N. D. Tomashov, G. K. Berukshits and A. A. Lokotilov. *Corrosion Tech. 5,* 386 (1958) Dec. (3 pp.)

Description of an apparatus construction to study basic principles of atmospheric corrosion both under laboratory conditions and for open-air tests. Mechanism of corrosion seems to be based on operation of microcorrosive elements under a thin film of moisture, or of wet corrosion products on the surface of a metal in atmospheric conditions. Atmospheric corrosion takes place not only in the presence of visible layers of water on the metal surface such as are due to rain-water or snow, but also in the case of high humidity of the air due to the hygroscopic nature of the corrosion products.

Gamma Rays + X-Ray Films = a New Way to Detect Corrosion. E. G. Pauschenwein and P. C. Trounce. *Oil Gas J. 56,* 64 (1958) Dec. 23 (3 pp.)

Combination of methods enables inspection engineer to record and plot corrosion with minute accuracy. First use was made by Canadian Oil Companies at Sarnia refinery in 1957, and since that time standardized procedures, equipment and measuring techniques have been developed to bring this method to the status of a major inspection tool.

New Hydrogen Sulfide Corroson Curves. E. B. Backensto and J. W. Sjoberg. *Petrol. Refiner 37,* 119 (1958) Dec. (2 pp.)

Recent laboratory data improves reformer rate prediction. Original iso-corrosion rate curves published in 1956 did not cover the range of hydrogen sulfide concentrations which these curves do. Result is a new tool for refinery corrosion engineers.

A Polarographic Study of the Corrosion of Iron and Some Ferrous Alloys by Sulfur Dioxide. F. J. Bowen and A. H. Gropp. *Corrosion 14,* 578t (1958) Dec. (5 pp.)

Study was conducted of the manner in which sulfur dioxide attacks iron and ferrous alloys. Polarographic method was used to follow changes in sulfur dioxide concentration. Tests were conducted on one pure iron and seven low alloy steels exposed to sulfur dioxide over 12-hour periods. Extensive data are reported on rate of consumption of sulfur dioxide by various test samples. Corrosion mechanism involving reduction of sulfurous acid by iron to give the sulfide is discussed.

Protective Coating and Cathodic Protection Practice in the Middle East. L. R. Sparrow. Part 1. *Petrol. 31,* 357 (1958) Oct. (6 pp.); Part 2. *Ibid.,* 444 (1958) Dec. (7 pp.)

Part 1 discusses corrosion of pipelines and its causes and materials used in pipe coating practice. In Part

2, the author discusses the practical problems connected with construction of groundbeds in the desert, sea loading lines and cables in the Middle East. Included are protection of terminals and tank farms, groundbed preparatory work, groundbeds and watertables, problems of marine protection and safety considerations.

Inhibitors

The Effect of Inhibitors of the Corrosion of Iron on the Air-formed Film. P. Hancock and J. E. O. Mayne. *J. Chem. Soc.*, 4172 (1958) Nov. (4 pp.)

Effect of 0.1N-sodium benzoate, acetate, borate, carbonate and hydroxide on the air-formed film on pickled mild steel, pickled iron or iron reduced in hydrogen was determined electrometrically. Air-formed film was reinforced and thickened by material of similar composition to the extent of 20-120% depending upon inhibitor and surface condition of the metal.

Metals

Extra Fatigue Strength Is Now Available. W. S. Hyler. (New York: SAE, 1958.)

Three key factors for good fatigue strength are cold working, residual stress and surface finish. Designers generally have not made use of all these factors in their calculations. Normal machining and finishing operations may produce fatigue strengths in metals far in excess of the as-received properties.

High-Temperature Metallurgy Today. L. P. Jahnke and R. G. Frank. *Metal Progress 74,* 86 (1958) Dec. (6 pp.)

Discussion of work on developing improved superalloys and refractory metal compositions. Class of superalloys is broad and includes iron-nickel, nickel and cobalt-base alloys. Refractory metals include tungsten, tantalum, molybdenum, columbium and chromium. Article gives properties of some of best superalloys and predicts future performance which can be expected from refractory metal alloys.

Materials of Construction—18th Biennial Report. *Chem. Eng. 65,* 137 (1958) Dec. 15 (40 pp.); **High-Temperature Metals.** E. Skinner. *Chem. Eng. 65,* 137 (1958) Dec. 15 (11 pp.); **Directory of Manufacturers.** *Ibid.*, 148 (1958) Dec. 15 (23 pp.); **Inventory of Current Literature.** *Ibid.*, 171 (1958) Dec. 15 (6 pp.)

Article contains practical, useful information on what metals to use in high-temperature chemical and petroleum process equipment and how to avoid costly application errors. New directory lists major manufacturers of materials of construction. Reference shows who makes what and gives product applications. Selected list of new literature gives up-to-date information on materials of construction.

Which Alloy for High Temp. Processes? E. N. Skinner and J. J. Moran, Jr. *Petrol. Refiner 37,* 133 (1958) Dec. (8 pp.)

Of the plant operations conducted at truly high temperatures, the two which require alloys of greater heat resistance than available in the extensively used straight chromium grades are the thermal cracking of hydrocarbons to form ethylene and the preparation of hydrogen or of feed gas for ammonia synthesis by steam-methane reforming. Two light hydrocarbon cracking heaters serve as the basis for a study of alloys in the high temperature range of 1500-1800°F.

Coatings

Pipe Coating Device. P. B. Botting and J. B. Killian. U.S. 2,862,276 (1958) Dec. 2.

Improved pipe coating machine is claimed, which comprises a mold with fixed semi-cylindrical bottom, and hinged upper sectors, with roller supports for proper annular positioning of various sizes of pipe, a detachable-clutch drive for rotating the pipe and seal-plug for defining end of coating horizontally, the coating material being fed from top hoppers and smoothed against mold surface by rotation.

Inhibitors

Prevention of Rust in Pipe Lines and Tankers with Ester-Type Wax Oxidate. J. C. D. Oosterhout (assigned to The Texas Company). U.S. 2,862,802 (1958) Dec. 2.

Corrosion of iron in pipelines and tanks containing light petroleum distillates is inhibited by an oxidized macrocrystalline paraffin wax having a Neutral No. of 60-100, a Sapon. No. of 200-300, and a Neutral No. to Sapon. No. ratio between 0.25–0.4, and with unsaponifiable below 40%.

12. ANALYTICAL METHODS AND TESTS

Acetylene

Determination of Acetylene in Air in Concentrations from Ten Parts per Billion to Ten Parts per Million. E. E. Hughes and R. Gorden, Jr. *Anal. Chem. 31,* (5 pp.)

Rapid, quantitative procedure for determining small quantities of acetylene in air is devised. Air is passed through a 2 x 10 mm column of silica gel cooled to –78°C. Column is warmed to room temperature and an ammoniacal cuprous chloride solution passed through. Intensity of the pink-red color produced is a measure of acetylene concentration.

Analytical Instruments

Stream Analyzers Cut Ethylene Cost. S. B. Spracklen and K. G. Halvorsen. *Petrol. Refiner 37,* 115 (1958) Dec. (4 pp.)

Ethylene process is one of many in petroleum, chemical and petrochemical fields for which savings can be effected by adequate instrumentation. Importance of process is shown by increased production of ethylene in past several years. Projected future market indicates a continued increase. For this reason process has a tremendous instrumentation potential. Example which shows a pay-out of less than four months is presented.

Chromatography

Gas Chromatography. II. Application to Gases in Industrial Laboratories. O. Horn, U. Schwenk and H. Hachenberg. *Brennstoff-Chemie 39,* 336 (1958) Nov. 12 (11 pp. German text.)

Previously described Janak system of chromatography using CO_2 carrier gas (*Gas Abstracts 13,* 169) was further applied to hydrocarbon mixtures of up to 30 components wherein each was determined within limits of 0.01-99.8 vol. percent. Unit developed by Farbwerke Hoechst AG, Frankfurt a. M.-Hoechst, using the heat conductivity detector and four interchangeable separating columns is described. Rapid quantitative operation with an example is shown for a 30-component cracked gas containing hydrogen, oxygen, nitrogen, carbon monoxide, carbon dioxide, methane, ethylene, ethane, acetylene, propane, propylene, allene, methyl acetylene, diacetylene, vinylacetylene, *iso-* and *n*-butane, *iso-* and *n*-butylene, *cis-* and *trans*-butylene (2), butadiene and C_5 hydrocarbons.

Gas Chromatographic Analysis. G. R. Boreham and F. A. Marhoff. G. C. Communication No. 54. *Gas World 148,* 975 (1958) Nov. 22 (2 pp.); *Coke and Gas 20,* 507 (1958) Dec. (2 pp.); *Gas Times 92,* 44 1958) Dec. (2 pp.). **Discussion.** *Gas World 148,* 1087 (1958) Dec. 6.

During the past few years there have been very rapid advances in chromatographic analysis methods, many of which are important to the gas industry. Thus, conventional methods for determining composition of gaseous mixtures, such as that of Bone and Wheeler, or the soap film technique, can now be replaced by gas chromatography.

Gas Analysis Sampling

Correct Procedures for Field Sampling Gas. N. E. Watson. *Pipe Line Ind. 9,* 40 (1958) Dec. (2 pp.)

Correct methods for taking field samples of gas are essential if laboratory analytical results are to reflect accurately the quality of gas purchased by the pipeline. Article discusses some worthwhile and practical suggestions that will help avoid contamination, minimize hazards and insure accurate records.

Gas Analysis

Gas Analysis by Optical Interferometry. D. N. Hanson and A. Maimoni. *Anal. Chem. 31,* 77 (1959) Jan. (6 pp.)

Optical interferometer is an accurate and reliable instrument for analysis of binary mixtures of gases. Theory and technique for analysis of hydrogen-nitrogen and deuterium-nitrogen mixtures are given. Accuracy is in the order of 0.1–0.5%.

Mass Spectrometer

Mass Spectrometric Analysis. Molecular Rearrangements. F. W. McLafferty. *Anal. Chem. 31,* 82 (1959) Jan. (6 pp.)

Classification of molecular rearrangement involved in structure determinations by mass spectrometry is presented. Random rearrangements are characterized by general reshuffling of the excited molecule-ion. Specific rearrangements are characterized by driving forces leading to degradation routes of lower energy requirements.

Petroleum Properties

Structures of Molecular Complexes Found in Heavy Petroleum Fractions. G. W. LeMaire. *Quarterly Colorado School of Mines 53,* (1958) Oct. (79 pp. incl. Bibl. and Appen.)

While many investigators have worked with heavy fractions from petroleum, it is only relatively recently that the studies in this area have been intensified. These studies have been concerned with the molecular structure of hydrocarbons normally present in gas oil and heavier distillates, in residues from crude oil distillation, in asphalts and coke, and in sediments containing hydrocarbons and other organic material. From these studies have come a number of generalizations and concepts concerning the origin and age of crude oil, the structures of the hydrocarbons present in the entire crude oil, the organic color bodies present in crude oil and various fractions derived from it by distillation, the structure of organic metallic compounds found in distillates and residues alike, and perhaps the greatest concept of all, the kinship of the hydrocarbons found in petroleum with those found in nature in the vegetable and animal kingdom.

Phenols

An Investigation into the Composition of Ammoniacal Liquor. L. Barker and N. W. Hollingworth. G. C. Communication No. 52. *Gas World 148,* 969 (1958) Nov. 22 (2 pp.); *Gas Times 92,* 59 (1958) Dec. **Discussion.** *Gas World 148,* 1079 (1958) Dec. 6.

Authors describe method for quantitative determination of phenols in ammoniacal liquors. Phenols are separated directly from 1 ml of an acidified liquor by column liquid-liquid partition chromatography, the concentrations being measured by ultraviolet spectrophotometry. Many phenols are completely resolved, though some appear in mixtures of a few isomers.

Sulfur Determination

Submicro-methods for the Analysis of Organic Compounds. V. The Determination of Sulphur. R. Belcher, R. L. Bhasin, R. A. Shah and T. S. West. *J. Chem. Soc.*, 4054 (1958) Nov. (3 pp.)

Sulfur in organic compounds can be determined by decomposing *ca.* 50 μg samples with fuming nitric acid and anhydrous barium chloride at 275-280°. The precipitated barium sulfate is centrifuged off, washed, and dissolved in an excess of ammoniacal 0.02_M-EDTA. Sulfur is determined indirectly by titration of the excess of chelating agent with standard 0.01_M-magnesium chloride. Average results for any one compound are within 0.20%; no result is likely to exceed by 0.4% the absolute sulfur content.

Sulfur Oxides

The Collection and Turbidimetric Estimation of Sulphur Trioxide in Flue Gases. D. H. Napier and M. H. Stone. *J. Appl. Chem. 8*, 787 (1958) Dec. (7 pp.)

Increased precision of turbidimetric determination of sulfur trioxide has been achieved by making refinements to a published technique and modifications to a commercially available instrument. Method has been improved by more careful control of several variables that affect the turbidity of barium sulfate suspensions. Improved method is applicable to solutions in the concentration range 1-80 mg/1 of sulfur trioxide, with a precision of $\pm$ 2% in the range of 6-80 mg/1 and a lower precision in the range 1-6 mg/1.

13. BASIC SCIENCE

Adsorption

The Adsorption of Gases on Ion Exchanged Mica. I. Argon and Krypton Isotherms and Bet Surface Area Measurements. G. L. Gaines, Jr. and C. P. Rutkowski. *J. Phys. Chem. 62*, 1521 (1958) Dec. (5 pp.)

Adsorption properties of ground muscovite mica bearing potassium, barium or cesium as exchangeable ions on its surface have been investigated. Isotherms for argon at 77°K from $p/p_o = 3.5 \times 10^{-7}$ to 0.75 and at 90°K from $p/p_o = 2 \times 10^{-7}$ to 0.3 are presented. These data are sufficient for the estimation of thermodynamic functions. Some data for krypton adsorption also are given. The effects of the ionic substitutions on the isotherms are noted, and the applicability of the BET method of surface area measurement to these data is discussed.

The Adsorption of Gases on Ion Exchanged Mica. II. Thermodynamics of Rare Gas Adsorption. G. L. Gaines, Jr. *J. Phys. Chem. 62*, 1526 (1958) Dec. (5 pp.)

Heats and entropies of adsorption for argon and krypton on ion exchanged micas have been computed from the data in a preceeding paper. These are presented and discussed in the light of existing knowledge of the nature of mica cleavage surfaces. Details of adsorption in the first layer can be rationalized by essentially geometrical considerations. When large polarizable cations and adsorbate atoms are involved, the character of the adsorption is modified. Applicability of the BET theory to these systems seems to depend on a "smoothing" of the surface in the earlier stages of adsorption. Some possibilities for further applications of mica cleavage surfaces in increasing understanding of physical adsorption phenomena are suggested.

Dissociative Adsorption of Methane and Ethane on Evaporated Metal Films. P. G. Wright, P. G. Ashmore and C. Kemball. *Trans. Faraday Soc. 54*, 1692 (1958) Nov. (11 pp.)

Adsorption of methane and ethane on evaporated metal films has been investigated. Observations were made at 0-100°C for both gases on tungsten and for ethane on nickel; for these systems the initial adsorption required no activation energy. Higher temperatures were necessary to adsorb methane on nickel (140°) and iron (170°) and ethane on iron (70°) because the initial adsorptions required activation. Adsorption of hydrocarbons usually led to formation of gaseous hydrogen, especially at the higher temperatures. Analysis of the gas phase by means of a Pirani gauge enabled gross composition of the adsorbed phase to be determined as CH_n C_{2n}. In some cases remarkably low values of n were observed after about 3 hours. Typical compositions were CH_2 at 100°C and C_2H_2 at 90°C on tungsten, $CH_{0.1}$ on nickel and CH_2 on iron at 200°C.

Carbon Black

The Organic Nature of Carbon Black Surfaces. II. Quinones and Hydroquinones by Coulometry at Controlled Potential. H. V. Drushel and J. V. Hallum. *J. Phys. Chem. 62*, 1502 (1958) Dec. (4 pp.)

Quantitative method for determination of quinone oxygen and hydroquinone hydroxyl on the surface

of carbon black by coulometric reduction or oxidation at controlled potential is described.

Contactors

Perforated Plate Efficiency-Effect of Design and Operating Variables. J. D. Hellums, C. J. Braulick, C. D. Lyda and M. Van Winkle. *A. I. Ch. E. J. 4,* 465 (1958) Dec. (7 pp.)

Experimental plate efficiency and pressure drop data were obtained on the *n*-octane-toluene system in a 5 plate, 6-in. diam. column at atmospheric pressure. Hole sizes of 1/16, 1/8 and 3/16 in.; 5.68 and 12.5% free areas; weir heights of 1, 2 and 3 in., and plate spacings of 6, 12, 18 and 24 in. were investigated. Reflux ratios of one, two, four, five, ten and total were utilized to determine the effect on efficiency. It was found that hole diameter, free area, plate spacing and a wide range of reflux ratio had relatively small effect on efficiency and pressure drop; however, weir height and lower reflux showed relatively larger effects on both variables. Efficiencies and pressure drops were lower than those predicted from published correlations, particularly at flow rates.

Radial Porosity Variations in Packed Beds. L. H. S. Roblee, R. M. Baird and J. W. Tierney. *A. I. Ch. E. J. 4,* 460 (1958) Dec. (5 pp.)

Radial variation of void fraction in randomly packed beds of spheres, cylinders, Raschig rings and Berl saddles was investigated. After packing, the beds were filled with paraffin, which was then allowed to solidify. Slabs were cut from the bed, and annular rings were removed by two different experimental techniques. Analysis of experimental error revealed that reproducibility, for the sample size used, between different parts of the same bed and different beds was quite good.

Density

Radiation Attenuation Method of Measuring Density of a Two-Phase Fluid. M. Petrick and B. S. Swanson. *Rev. Sci. Instruments 29,* 1079 (1958) Dec. (7 pp.)

Gamma-ray attenuation technique is presented for measuring density and phase distribution in a two-phase fluid. Comparison is made between a "one-shot" and traverse method. Technique was evaluated on Lucite mock-ups of simulated flow patterns encountered in two-phase flow and by a series of tests on an air-water system at atmospheric pressure.

Diffusion

A Method for the Numerical Integration of the Linear Diffusion Equation. D. R. Hartree. *Appl. Mech. Rev. 11,* 700 (1958) Dec. (From *Proc. Campbell Phil. Soc. 54,* 207 (1958) Apr. (8 pp.)).

In one numerical method for integration of the diffusion equation in one dimension, the time derivative is replaced by a finite difference in a time interval. This leads to a set of ordinary differential equations, one for each interval, which have to be solved in succession. Each of these equations is second-order with two-point boundary conditions; the process of integration from one end is severely unstable, the more so the smaller the time interval. Paper is concerned with a practical, direct and stable method for solving them by integration of two first-order equations, one being integrated inwards and the other outwards, one boundary condition being satisfied in each integration. The extension to axially symmetrical diffusion is briefly considered.

From author's summary by Y. L. Like, USA

Equation of State

Density: Reduced-State Correlations for the Inert Gases. C. S. Hamrin, Jr. and G. Thodos. *A. I. Ch. E. J. 4,* 480 (1958) Dec. (5 pp.)

Principle of corresponding states has been adopted to the correlation of densities and found to be applicable for nonpolar substances when the critical compressibility factor is introduced as an independent parameter. For the inert gases, densities available in the literature for the gaseous and liquid states have been referred to their critical densities to produce reduced-state correlations which are identical only when their corresponding critical compressibility factors are the same. As a result, a consolidated reduced density correlation for $z_c = 0.291$ has been developed from experimental data for argon, krypton, and xenon. Although the z_c values for helium and neon are essentially alike, different reduced-state correlations for these substances were found to exist. This behavior is expected in view of the radical nature of helium, which can be accounted for by its excessive quantum deviation. Therefore, the reduced density correlation for neon ($z_c = 0.307$) is selected as representative of that class of substances having similar z_c values.

Volumetric Properties of Nonpolar Gaseous Mixtures. J. M. Prausnitz and R. D. Gunn. *A. I. Ch. E. J. 4,* 430 (1958) Dec. (6 pp.)

Volumetric data of nonpolar gaseous mixtures are analyzed in terms of the theory of corresponding states. Special attention is given to an analysis of the second virial coefficient and to the calculation of pseudocritical constants. Second virial coefficients are calculated from experimental data for ten binary systems. These coefficients, with those previously published, are correlated by means of a generalized equation involving three parameters for each component: The critical volume, the reduced

temperature and the acentric factor. Equations are derived from the pseudocritical temperature and pressure of mixtures. These equations are considerably more accurate than those given by Kay's rule. Because of the complexity of the proposed equations for the pseudocritical parameters, a simplified pseudocritical method is presented which is sufficiently accurate for most chemical engineering purposes, especially at reduced temperatures exceeding 1.3.

Fluidization

Characteristics of Gas Pockets in Fluidized Beds. G. Yasui and L. N. Johanson. *A. I. Ch. E. J. 4,* 445 (1958) Dec. (8 pp.)

Some characteristics of gas pockets rising through beds of fluidized solids have been measured directly with a light probe technique. The vertical thickness, numerical frequency and rate of rise of the bubbles were obtained from oscillographs of dual probe signals. Room-temperature air at 1-atm. pressure was used in 4- and 6-in. columns. Glass beads, a crushed rock, commercial cracking catalysts, coal and hollow resin spheres were studied in particle sizes from 12-μ fluid cracking catalyst to 450-μ coal.

Surface Dynamics of Fluidized Beds and Quality of Fluidization. W. J. Rice and R. H. Wilhelm. *A. I. Ch. E. J. 4,* 423 (1958) Dec. (7 pp.)

Solutions of linearized Navier-Stokes equations have been developed for the motion of arbitrary two-dimensional waves occurring at any interface between the emulsion phase of a fluidized bed and the particle-free, fluid phase. In all cases for which the bed particles are denser than the fluidizing fluid, the solutions showed that the lower interface of a bed always is unstable and the upper stable. The quality of fluidization is suggested to be related at least in part to the rate of growth of surface waves, this rate depending upon physical properties of the system and length of the disturbing wave.

A Theoretical-Empirical Approach to the Mechanism of Particle Entrainment from Fluidized Beds. F. A. Zenz and N. A. Weil. *A. I. Ch. E. J. 4,* 472 (1958) Dec. (8 pp.)

Means of calculating the rate of entrainment of solids from commercial-size continuously operating fluidized beds was developed from the combined results of a theoretical and an empirical approach which through different channels arrived at the same fundamental mechanism. Calculation method shows agreement with data obtained from an apparatus simulating flow characteristics in large-scale equipment and compares favorably with smaller scale tests reported in the literature at pressures up to 200 psi gauge.

Fluid Flow

Laminar Flow in a Uniformly Porous Channel. F. M. White, Jr., B. F. Barfield and M. J. Goglia. *J. Appl. Mech. 25,* 613 (1958) Dec. (5 pp.)

Problem of laminar channel flow was investigated for case of uniform fluid suction or injection through channel walls. Solution can be divided into three steps: 1) judicious choice of stream function reduces the Navier-Stokes equations to an ordinary fourth-order, nonlinear differential equation, which contains a free parameter, R, the Reynolds number based upon fluid velocity through the wall; 2) since general analysis of this equation is intractable, the parameter, R, is eliminated by a suitable transformation; 3) transformed, nonparametric equation uniformly yields to a series solution, valid and absolutely convergent for all R. From this general solution, expressions are developed for velocity components, pressure distribution and wall-friction coefficient.

Unresolved Problems of Fluid Mechanics. S. J. Kline and R. C. Dean, Jr. *Mech. Eng. 80,* 54 (1958) Dec. (2 pp.)

Results of survey conducted by Fluid Mechanics Subcommittee of the ASME suggest that two general types of unsolved problems are currently of most concern to mechanical engineers: 1) stall or flow separation and its associated transient effects and 2) two-phase flow. Authors present their conclusions, drawn from the survey and their own experience.

Heat Transfer

The Method of Average Temperature for the Study of the Process of Heating a Solid Body. E. V. Kudriavtsev and N. V. Shumakov. *Appl. Mech. Rev. 11,* 698 (1958) Dec. (From *Soviet Phys.-Tech. Phys. 2,* 782 (1958) Apr. (12 pp.) Russian text.)

On the basis of the analysis of several cases of nonstationary bilateral heat transfer to or from an infinite plane-parallel plate of thickness 2 R, the authors conclude that the variation with time of temperature at the plane with the coordinate $(3)^{1/2} R/3$ corresponds satisfactorily to the variation of the average plate temperature for any form of boundary function. Since the amount of heat entering a body during a heating process is given by the product of its heat capacity and the increase of its average temperature, it is then possible, from the experimentally found time-temperature relation in a point of the mentioned plane, to determine the density of thermal fluxes averaged over suitable chosen successive time intervals and to find out the form of the boundary function characterizing the heat exchange.

[F. Krupka, Czechoslovakia]

A Method for the Experimental Study of the Process of Heating a Solid Body. N. V. Shumakov. *Appl. Mech. Rev. 11,* 697 (1958) Dec. (From *Sov. Phys.-*

Tech. Phys. 2, 771 (1958) Apr. (11 pp. Russian text.)

Method called "method of successive intervals" is presented for determining boundary functions characterizing heat exchange during heating or cooling an infinite plane-parallel plate from experimentally found time dependences of changes of the temperature field in the plate. Process of heating is broken up into separate time intervals and temperature distribution in the plate in each interval is computed on supposition that boundary function is constant. Solution obtained gives a connection between temperature field in the plate during heating process and variable thermal fluxes entering plate at definite stages of heating process. Analysis is made of questions relating to construction of a device for studying the local nonstationary heat transfer between solid bodies of large dimensions and complicated configuration and surrounding medium based on a measuring element consisting of a cylindrical portion of such an infinite plane-parallel plate.

F. Krupka, Czechoslovakia

Turbulent Heat Transfer Inside Tubes and the Analogy Among Heat, Mass and Momentum Transfer. W. L. Friend and A. B. Metzner. *A. I. Ch. E. J. 4,* 393 (1958) Dec. (10 pp.)

Effect of fluid physical properties on the rates of convective heat transfer (or mass transfer) to Newtonian fluids flowing turbulently inside tubes has been studied extensively but never resolved for a wide range of variables. In the absence of precise experimental data, the conflicting predictions of the many semitheoretical approaches developed during the last two decades have served to confuse rather than to clarify the basic question. To extend the range of the available data an experimental heat transfer study of the heretofore undefined region of high Prandtl number was performed. Fluid properties, determined experimentally, represented a variation in Prandtl number from 50-600.

Hydrocarbons

The Densities of Liquid C_3 and C_4 Alkenes at Temperatures Above Their Boiling Points. D. W. Morecroft. *J. Inst. Petrol. 44,* 433 (1958) Dec. (2 pp.)

Liquid densities, under their own vapor pressures, of propene, butene-1, *cis*-butene-2 and *trans*-butene-2 have been measured over the temperature range of 0°-80°C.

Oxidation Mechanism of Hydrocarbons. Free Radical Reactions in the Gas Phase. J. H. Knox. *Petrol. 21,* 435 (1958) Dec. (4 pp.)

Two previous articles (see *Gas Abstracts 14,* 350) have shown how far it is now possible to determine experimentally the absolute rate constants of a large number of free radical reactions in the gas phase. These advances, made chiefly since 1945, have largely been made possible by the development of methods of preparation of certain free radicals in a pure state under conditions where they can be made to react cleanly, and where rates of their reactions can be obtained by the analysis of characteristic products. However, comparable advances have not been made in the study of the reactions of free radicals such as OH, HO_2, RO and RO_2, which are important in hydrocarbon oxidation reactions, and the direct study of the mechanism of hydrocarbon oxidation is still one of the most important ways of investigating their properties.

Hydrogen

Kinetics of Hydrogen Absorption, Desorption and Permeation of Metals. T. G. Owe Berg. *Corrosion 14,* 562t (1958) Dec. (5 pp.)

Reaction mechanisms for the absorption of hydrogen by metals from moist hydrogen gas and dilute acid solutions, for the desorption from metals of dissolved hydrogen in the presence of water and for hydrogen solubility and permeation under those conditions are discussed. Their kinetics also are given. Formulae are derived for rates and equilibria. These are compared with experimental data. Migration of H atoms in the metal is concluded to be associated with zero or nearly zero activation energy. Diffusion is rapid enough to maintain almost uniform distribution of H atoms in the metal during absorption and desorption under ordinary conditions.

Liquefaction

Cryogenics—Key Process and Research Tool. J. E. Nachod, Jr. *Petrol. Eng. 30,* C-12 (1958) Dec. (4 pp.)

Cryogenics, science of extremely low temperatures, divides into four principal areas: 1) gaseous separations; 2) energy storage; 3) sensitive measurements, and 4) basic research. Article gives process details, relative operating costs and applications for low temperature separation of gases.

Nitrogen Oxides

Reaction of Oxygen Atoms with Nitric Oxide. P. Harteck, R. R. Reeves and G. Mannella. *J. Chem. Phys. 29,* 1333 (1958) Dec. (3 pp.)

Rate of reaction of oxygen atoms with nitric oxide has been studied at several pressures (0.62, 0.85, 1.11 mm Hg) by measuring relative intensities of the oxygen afterglow. Consumption of 0 atoms was observed as a three-body recombination ($NO + 0 + M \rightarrow NO_2 + M$). At room temperature reaction coefficient was found to be $k_2 = 7.6 \times 10^{32} cm^6$ molecules^{-2} sec^{-1}, with an average derivation of 6.5%. The third body was mainly argon.

Olefins

Photooxidation of Butenes by Nitrogen Dioxide at Different Wave Lengths. S. Sato and R. J. Cvetanovic. *Can. J. Chem. 36,* 1668 (1958) Dec. (6 pp.)

Photooxidation of butenes by nitrogen dioxide at room temperature has been studied at three different wave lengths: 2288, 2537 and 3261 A. In the case of butene-1 an abrupt change in the ratios of reaction products is observed between 2537 and 2288 A. Reactions of *cis*- and *trans*-butene-2 and of isobutene are much less reproducible, particularly so that of isobutene, because of the much more readily occurring thermal reaction of the excess nitrogen dioxide present with the epoxides initially formed.

Phase Equilibria

On Phase Equilibrium at the Gas Liquid Interface During Absorption. L. E. Scriven and R. L. Pigford. *A. I. Ch. E. J. 4,* 439 (1958) Dec. (6 pp.)

That phase equilibrium exists at the gas-liquid interface during gas absorption is usually assumed in the analysis and design of absorption equipment, but the validity of this assumption has been in doubt since Higbie's pioneering gas-absorption studies. Accurate measurements are reported of the absorption rates at 25°C. of carbon dioxide into short water jets in which the liquid was in laminar flow. The jets issued from circular nozzles of about 1.5-mm. diam. flowed intact downward through an atmosphere of carbon dioxide at average velocities of from 75-550 cm/sec over distances of 1-15 cm, and were collected in a receiver slightly larger in diameter than the nozzles. Measured absorption rates are in excellent agreement with predictions based on unsteady state diffusion theory, when one assumes interfacial equilibrium. It is concluded from these results and those of other investigators that equilibrium prevails at a freshly formed, relatively clean, carbon dioxide-water interface and that the same statement probably applies to the absorption of other slightly soluble gases in water.

Thermal Conductivity

Thermal Conductivity of Multicomponent Gas Mixtures. C. Muckenfuss and C. F. Curtiss. *J. Chem. Phys. 29,* (1958) Dec. (5 pp.)

Equation is derived from complete second approximation to the thermal conductivity of multicomponent gas mixtures. Result is found to be identical with an "approximate" formula for the thermal conductivity derived on the assumption that the thermal diffusion coefficients are negligibly small.

Thermodynamics

Internal Energy-Compressibility-Temperature Equation for Air in Dissociative and Ionic Equilibrium. P. Winchell. *J. Chem. Phys. 29,* 687 (1958) Oct. (2 pp.)

Based on the real gas data of Hilsenrath and Beckett an equation is proposed to described air in dissociative and ionic equilibrium over wide state-variable intervals. Used in conjunction with a suitable real gas state equation, an entropy-compressibility-density relation, and pertinent conservation equations, proposed equation should complete a realistic, consistent set of dynamic and thermodynamic equations. Proposed equation exhibits excellent agreement with data in sample calculations.

Thermoelectricity

Applications of Thermoelectric Cooling and Heating. R. S. Lackey, J. D. Meess and E. V. Somers. *Refrigerating Eng. 66,* 31 (1958) Dec. (6 pp.)

Applications discussed in article are intended to show some possibilities of utilization of thermoelectric cooling and heating in appliances. Individual design problems discussed are somewhat characteristic of those associated with development of any of the new purpose thermoelectric refrigerating devices.

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American Gas Journal
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American Petroleum Institute Quarterly
American Society for Testing Materials Bulletin
Analytical Chemistry
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Applied Spectroscopy
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Australian Journal of Chemistry

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Bituminous Coal Research
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British Coal Utilization Research Association Monthly Bulletin and *Quarterly Gazette*
Business Week
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California Oil World
Canadian Chemical Processing
Canadian Gas Journal
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Engineers' Digest (British)
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Gas Age
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Gas Council Research Communications (British)
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Gas Industries
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Gas Times (British)
Gas- und Wasserfach (German)
Gas World (British)
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Heating, Piping & Air Conditioning

Independent Petroleum Association of America Monthly
Industrial and Engineering Chemistry
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Industrial Gas (American)
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Industrial Heating
Industrial Laboratories
Industrial Research
Institute of Fuel, Journal of (British)
Institute of Gas Technology Research Bulletins
Institute of Petroleum, Journal of (British)
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Instrumentation
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Izvestiya Akademii Nauk S. S. S. R. Otdelenie Khimicheskikh Nauk (Russian)

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Khimiya i Tekhnologiya Topliva i Masel (Russian)

LP-Gas
Lubrication
Lubrication Engineer

Mathematical Tables and Other Aids to Computation
Mechanical Engineering

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National Petroleum News
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Nucleonics

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Product Engineering
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Science
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Svenska Gasverksföreningens Månadsblad (Swedish)

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U.S. Bureau of Mines Bulletins, Information Circulars and Reports of Investigations
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World Oil
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